Understanding the Role of Planning in the Performance of Complex Prospective Memory Tasks

A Dissertation
Presented to
The Academic Faculty

by

Aideen J. Stronge

In Partial Fulfillment
of the Requirements for the Degree
Doctorate of Science in Psychology
in the School of Psychology

Georgia Institute of Technology
August 2006

Understanding the Role of Planning in the Performance of

Complex Prospective Memory Tasks

Approved by:

Dr. Wendy A. Rogers, Advisor
School of Psychology
Georgia Institute of Technology

Dr. Arthur D. Fisk
School of Psychology
Georgia Institute of Technology

Dr. Fredda Blanchard-Fields
School of Psychology
Georgia Institute of Technology

Dr. Anderson D. Smith
School of Psychology
Georgia Institute of Technology

Dr. Elizabeth D. Mynatt
College of Computing
Georgia Institute of Technology

Date Approved: June 26, 2006

This dissertation is dedicated to my parents, William and Joyce Stronge.

ACKNOWLEDGEMENTS

I would like to acknowledge my committee members, Wendy A. Rogers, Arthur D. Fisk, Fredda Blanchard-Fields, Anderson D. Smith, and Elizabeth D. Mynatt for their insightful suggestions and helpful comments that helped to shape this dissertation. In particular, I would like to thank Wendy A. Rogers and Arthur D. Fisk for their guidance, direction, and patience in accomplishing this goal. You have been superb mentors and I cannot thank you enough for your support. I would also like to thank my friends in the Human Factors and Aging Lab. In particular, I would like to extend a special thanks to Lisa, Jamye, Rich, and Holly. I could never have come this far without you. Finally, I would like to thank my number one supporters, Vollie Scroggins, Mr. Tiggs, and Miss Nala.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

Prospective memory – also known as remembering to remember – is a process to remember to carry out future actions (Chasteen, Park, & Schwartz, 2001). Prospective memory tasks require a person to remember specific information (*what*) for a specific retrieval cue (*when*) without an explicit demand for the information to be retrieved (Craik, 1986). Although age-related declines might have been predicted in the performance of prospective memory tasks, research studies have generated mixed findings (e.g., Light, 1991). A source of the conflicting findings appears to be related to the type of cues available at retrieval, as well as the types of tasks used to investigate prospective memory such that some retrieval cues (e.g., event-based) and some tasks (e.g., familiar) provide more environmental support than others.

People construct plans in the prospective memory process when they establish cues for *how* they will remember an intention by considering *what* (the action) needs to be remembered and *when* (the retrieval context) it needs to be remembered (Ellis, 1996). The development of an effective plan would be critical in the performance of a complex prospective memory task; complexity in this case is defined as remembering multiple subtasks at different times.

Previous research studies have found age-related declines in planning for novel complex prospective memory tasks (Kliegel, Martin, & Moor, 2003; Kliegel, McDaniel, & Einstein, 2000). However, participants may develop more effective plans for a familiar task because their experience provides them with a better understanding of the goals of the task and how to achieve those goals (Martin & Ewert, 1997). Age-related declines also have been observed in the performance of a familiar complex prospective memory task (Craik & Bialystok, in press). Although this finding was interpreted in

terms of poor planning, the study did not directly measure plan development. Thus it is unclear whether the source of the age-related declines in planning occurred during plan development, plan implementation, or both.

The overall goal of this dissertation was to understand how people developed and implemented plans in the performance of complex prospective memory tasks, and whether their plans and subsequent performance differed by the age of the person and/or by the type of task. The two tasks selected for this study were a medication planning task and a group planning task. Both tasks had eight subtasks (e.g., Medication 1, Medication 2) that varied in their level of complexity. The subtasks varied by whether they had a rule, had to be performed everyday, and the number of times that they had to be performed during the week (i.e., one time during the week or multiple times). Although both tasks had similar wording and constraints, it was hypothesized that age-related differences in performance would be reduced for the medication planning task because older adults would be able to draw upon their experience developing effective plans to remember their own medication regimens.

Participants completed both tasks within two simulated weeks based on activities they perform as part of their weekly routine. Participants were presented with information about the day of the week (e.g., Monday), the activity that they typically perform at that time (e.g., breakfast), and any details about that activity (e.g., coffee and pancakes). The time was not readily available to participants, but they could press a key to access the exact hour that the activity was performed (e.g., 9 AM). Participants also were engaged in another task – the party attendance task – which was analogous to a 1-back task and involved remembering the responses for people attending a party (e.g., Smith Yes). The party attendance task was included to prevent participants from keeping the prospective memory task active in working memory.

Participants' experience planning was assessed by the planning experience questionnaire (PEQ) which asked participants whether they engaged in planning activities across five different domains (e.g., health, finance, social). Five different domains were selected because participants may plan more in some domains than others. Participants reported using planning strategies relatively frequently. Older adults had more planning experience than younger adults as assessed by the planning experience questionnaire (PEQ). Older adults also had significantly more planning experience within three of the domains: health, volunteering/work, and finance.

Plan development was assessed by using both quantitative and qualitative measurements. Quantitative measures of plan development included time to plan and accuracy of the plans (according to the rules specified for the task). Older adults required more time to plan, but their plans were as accurate as those of the younger adults.

Participants' plans also were coded into four qualitative planning styles depending on the layout and the type of retrieval cue: (1) chart layout/time-based cue, (2) chart layout/event-based cue, (3) list layout/time-based cue, and (4) list layout/event-based cue. There were no age-related differences in planning style for the group planning task, but there were age-related differences for the medication planning task. Younger adults were more likely to use a chart layout/time-based planning style whereas older adults were more likely to use a list layout/time-based planning style. Moreover, within an age group, younger adults were more likely to use the same planning style for both tasks whereas half of the older adults used a different planning style for the two tasks. This finding provides evidence that experience may have influenced older adults' plan development.

Prospective memory performance was measured by the number of prospective cost errors (omissions, commissions, rule breaks, and number of times they checked the time) and total cost errors (prospective cost errors + party attendance errors). Age-related differences in plan implementation were observed such that older adults made more prospective cost errors and total cost errors than younger adults for both the group planning task and the medication planning task.

The relationship between the planning style (i.e., plan development) and performance (i.e., plan implementation) was assessed to investigate the source of the age-related declines in plan implementation (i.e., do certain planning styles result in lower levels of performance?). In general, there was no relationship between planning style and prospective memory performance for the group planning task. However, for the medication planning task, planning style had an influence on age-related differences in performance. Age-related differences in performance emerged when participants used a list layout/time-based planning style. It is not surprising that age-related differences were found for this planning style as the layout and retrieval cue provided the least amount of environmental support. Moreover, it appears that planning style was related to amount of planning experience because participants with higher levels of planning experience were more likely to choose a chart layout/time-based planning style whereas participants with lower levels of planning experience were more likely to choose a list layout/time-based planning style. A chart would have been a more effective planning layout for this task because it organizes information by day and hour and the prospective memory tasks were structured by day and hour.

In summary, the goal of the present research was to understand age-related differences in the performance of complex prospective memory tasks when participants were given the opportunity to participate in a familiar task (i.e., medication planning) and develop their own plans. Prospective memory is a complex task with multiple components and a complete understanding of age-related differences must investigate all of those components. Older adults were capable of developing accurate plans – however they did not always develop the most effective plans as evidenced by their lower rate of chart-based plans and event-based plans. Moreover, age-related differences in prospective remembering were most related to the type of plan that had been developed. These findings illustrate the importance of experience for successful planning in the context of prospective memory tasks because older adults developed better plans for the medication planning task which reduced age-related differences in performance.

CHAPTER 1

INTRODUCTION

Consider the following scenario. Ruth, an active and functionally independent seventy-year-old, wakes up in the morning and enters the bathroom to brush her teeth. When she opens her bathroom cabinet, there is a medication organizer sitting atop her toothbrush. Ruth takes her medications, brushes her teeth, and replaces the toothbrush and medication organizer in the cabinet. She checks the calendar on the refrigerator to verify her 9AM doctor’s appointment. She quickly dresses, grabs her keys, and notices a pad of paper underneath her keys. She smiles to herself remembering that she placed the pad there to ensure she would not forget it; the pad contains a list of questions she intends to ask her doctor. She pauses once more to glance around her home. Reassured she has not forgotten anything, she leaves her home to begin the day.

This scenario demonstrates how an older adult (or a person of any age) might rely on cues in the environment to remember intentions. Prospective memory is the process involved in translating an intention into an action when there is a delay before it can be fulfilled (Ellis, 1996; Kvavilashvili & Ellis, 1996). Examples of prospective memory tasks include remembering to attend important meetings, remembering to turn the oven off after cooking a meal, and remembering to take medication at the prescribed time.

Prospective memory has great relevance for our everyday lives (Kliegel & Martin, 2003). There is evidence that 50-80% of all everyday memory problems are prospective memory problems (Crovitz & Daniel, 1984; Terry, 1988) and the ability to remember to perform intentions has been shown to be a major prerequisite for successful independent living (Kliegel, in press; Martin, 2001).

As part of the prospective memory process, people construct plans whereby they might establish cues for *how* they will remember an intention by considering *what* (the action) needs to be remembered and *when* (the retrieval context) it needs to be remembered (Ellis, 1996). The overall goal of my dissertation was to understand how people develop and implement plans in the performance of complex prospective memory tasks, and whether their plans and subsequent performance differed by the age of the person and/or by the type of task.

Theoretical Background

Successful memory performance involves encoding information and reconstructing the encoding event at retrieval to remember the information (Craik, 1983). A person is more likely to remember information that is encoded in a distinct or meaningful way (Craik). Older adults have been shown to use organizational strategies, mnemonics, and imagery less frequently than younger adults to encode information (Craik). Older adults may use these methods less frequently because the mental energy or processing resources available to a person becomes limited with advanced age, and these methods are effortful requiring a person to engage in self-initiated processing (Craik; Salthouse, 1982).

Memory performance, however, is not solely dependent on the amount of self-initiated processing required by the person at encoding (Craik, 1986). Memory tasks also differ in their self-initiated processing requirements at retrieval (Craik, 1977; 1986). For example, successful recall for a cued recall task (e.g., fill-in-the-blank) is more demanding than a recognition task (e.g., multiple-choice) because the latter task provides external cues at retrieval (i.e., environmental support) (Craik, 1977; Craik, 1983; Craik

1986). Perhaps not surprisingly, age-related differences are reduced in the performance of recognition tasks when compared to free recall tasks (e.g., Craik & McDowd, 1998; Schonfield & Robertson, 1966).

Environmental support reduces age-related differences in performance by reducing demands on self-initiated processing (Craik, 1986). The original definition of environmental support focused on the external cues available at retrieval. However, this definition can be expanded to include guidance during encoding (Chasteen, Park, & Schwarz, 2001) and the use of tasks with which the participant is familiar (Zacks, Hasher, & Li, 2000).

The role of environmental support in memory is particularly relevant for the study of prospective memory. Craik's (1983; 1986) original model of environmental support predicted the greatest age-related declines in performance for prospective memory tasks because of the requirement to remember *what* needs to be remembered (retrospective component) and *when* it needs to be remembered (prospective component) presumably without explicit retrieval cues to remind the person of either component. As a result, Craik listed prospective memory as lowest in environmental support, highest in self-initiated processing requirements, and predicted that the largest age-related declines would be observed in the performance of prospective memory tasks.

Investigations into age-related differences in prospective memory, however, have generated mixed findings (see Light, 1991). When compared to younger adults, older adults have been shown to exhibit poorer prospective memory performance (Einstein & McDaniel, 1990), equivalent prospective memory performance (e.g., Rendell & Thomson, 1993; West, 1988, Experiment 1), and better prospective memory performance

(Rendell & Thomson, 1999). Recent research investigations into prospective memory have found that there are cues at retrieval for prospective memory tasks, these retrieval cues provide differing amounts of environmental support, and the locus of the discrepant findings in the aging literature may lie within the nature of these retrieval cues (Marsh, Hicks, & Cook, 2005).

The Role of Retrieval Cues

The presence of age-related declines in prospective memory performance has been shown to be closely related to the type of retrieval cue provided (Einstein & McDaniel, 1990). For example, age-related declines have been observed when the retrieval cue is time-based (perform the action at a certain time or after a certain amount of time has passed) whereas age-related declines in prospective memory are reduced when the retrieval cue is event-based (perform the action after an event has occurred) (Einstein & McDaniel, 1990; Einstein, McDaniel, & Richardson, 1995). Time-based retrieval cues require a person to engage in active monitoring whereas event-based retrieval cues provide an external cue to trigger memory (Einstein & McDaniel, 1990; Henry, MacLeod, Phillips, & Crawford, 2004). Consistent with Craik's (1986) reasoning, age-related declines emerge when the retrieval cue is time-based because time-based retrieval cues provide less environmental support and are more in demand of self-initiated processing resources than event-based retrieval cues (Einstein & McDaniel, 1990; Einstein, McDaniel, Richardson, Guynn, & Cunfer, 1995).

Age-related declines in performance, however, have not been observed when prospective memory tasks are conducted outside of the laboratory even when the retrieval cues are time-based (e.g., Rendell & Thomson, 1993; West, 1988, Experiment 1). Older adults may exhibit performance improvements in studies conducted outside the laboratory because they can place additional retrieval cues in the environment to remind them of the intention (e.g., note on a calendar, setting an alarm) (Einstein, McDaniel, & Richardson, 1995). To illustrate, older adults have reported converting time-based retrieval cues into event-based retrieval cues by associating the prospective memory task with an event in their daily lives (i.e., "call the experimenter at 3PM" becomes "call the experimenter when my favorite TV show begins", otherwise known as conjunction cues) (Maylor, 1990). These additional retrieval cues would provide increased environmental support to help older adults maintain their performance despite age-related declines in processing resources.

Our current understanding of how older adults establish retrieval cues to aid their prospective memory performance is incomplete because participants were not given the opportunity to develop retrieval cues for studies conducted inside the laboratory (Einstein & McDonald, 1990), and were often explicitly told *not* to use retrieval cues (e.g., "memory aids", "memory strategies") in studies conducted outside of the laboratory (e.g., Rendell & Craik, 2000). Moreover, in studies conducted outside of the laboratory, there is a lack of control over whether participants are relying on retrieval cues. In general, the use of retrieval cues is assessed by asking participants whether they relied on a "strategy", "aid", or "plan" to support their performance (e.g., Rendell & Thomson, 1999, Experiment 1). Participants may not understand what researchers mean by the terms used to describe their behavior (e.g., "strategy") (Dobbs & Rules, 1987). Therefore, it is unknown whether there are age-related differences in the development of retrieval cues for prospective memory tasks or whether certain retrieval cues facilitate prospective memory performance more than others.

People engage in planning for prospective memory tasks when they choose retrieval cues to remind them *what* needs to be performed and *when* it needs to be performed (Ellis, 1996; Dobbs & Reeves, 1996). To remember intentions, older adults may rely on retrieval cues that provide more environmental support than younger adults to maintain their performance. A systematic assessment of how people develop and implement plans to remember prospective memory tasks is needed to understand why (and under what circumstances) age-related differences in prospective memory emerge.

Age-related Differences in Planning

Planning in the context of memory requires developing or selecting a plan appropriate for the task (i.e., plan development), and then successfully executing the plan (i.e., plan implementation) (Bisiacchi, Sgaramella, & Farinello, 1998). In the cognitive aging literature, two distinct paradigms have been used to understand age-related differences in planning: "puzzle-based" procedures (e.g., Tower of Hanoi), and how people plan during everyday tasks such as running errands (see Lachman & Burack, 1993; Morris & Ward, 2005, for a review). The main difference between these two tasks is that puzzle-based procedures are not familiar tasks to most participants.

In general, there are clear age-related declines in plan development and plan implementation for puzzle-based procedures (Morris & Ward, 2005). However, puzzle-based procedures may not provide insight into how people plan in their everyday lives, and older adults may not be motivated to perform well in these tasks because of their artificial nature (Morris & Ward). Older adults may demonstrate performance improvements in planning when familiar tasks are used because their experience provides them with a greater understanding of the goals of the task and how to achieve those goals (Martin & Ewert, 1997). Everyday planning tasks allow older adults to use a lifetime of knowledge planning these tasks and may tap into aspects of cognition that do not show declines with age (Martin & Ewert) hence reducing demands on self-initiated processing resources and providing increased environmental support (Zacks et al., 2000).

The everyday tasks that have been used to investigate age-related differences in planning have included an errand planning task in a fictitious environment (Bisiacchi, Sgaramella, & Farinello, 1998), putting together a flyer about a trip for fictitious people (Martin & Ewert, 1997), planning a fictitious cocktail party (MacLeod, 2001 unpublished study reported in Phillips, Macleod, & Kliegel, 2005), cooking a fictitious breakfast (Craik & Bialystok, in press), and an errand planning task conducted outside of the laboratory (Garden, Phillips, & McPherson, 2001). In general, age-related declines have been observed in planning for these everyday tasks. However, a limitation of these research studies was the focus was either plan development or plan implementation and not the relationship between the two making it difficult to know the source of the age-related declines in performance (i.e., plan development, plan implementation, or both).

Therefore, our understanding of age-related differences in planning for familiar contexts is limited because investigations into plan development have not provided the opportunity to understand plan implementation and conversely, investigations into age-related differences in plan implementation have not provided a measure of plan development (Phillips, MacLeod, & Kliegel, 2005). Moreover, the goal of the studies mentioned above was not to understand how people plan to remember intentions (i.e., prospective memory), but focused on whether participants remembered to follow rules in the performance of a task.

One reason that few prospective memory studies have investigated the role of planning is because most studies have investigated only a single intention to be performed at one time or repeated (Marsh, Hicks, & Landau, 1998) with a single cue (Cohen, West, & Craik, 2001) that did not require much planning on the part of the participant (Bisiacchi, 1996). Complex prospective memory tasks, however, often involve performing *multiple tasks* at *different* times thereby increasing both the retrospective (*what needs to be remembered*) and prospective (*when does it need to be remembered*) components of the task. For example, adherence to a medication regimen could necessitate taking multiple medications at different times with each medication having specific instructions (e.g., do not take this medication with food). As the complexity of the task increases, the role of planning becomes critical for successful performance because there may be multiple retrieval cues to remind a person to perform different intentions (Dobbs & Reeves, 1996; Ellis, 1996; Kliegel, Martin, & Moor, 2003).

Planning in Complex Prospective Memory Tasks

The role of planning has been investigated in the performance of complex prospective memory tasks (Craik & Bialstok, in press; Kliegel, Martin, & Moor, 2003; Kliegel, McDaniel, & Einstein, 2000). In a task used by Kliegel and colleagues (adapted from Shallice and Burgess, 1991), participants engaged in a battery of tests while needing to remember to perform a prospective memory task after answering a specific question in a questionnaire. The experimenters distinguished the requirements to remember the prospective component of the task (*when*) from the retrospective component (*what*) such that all six subtasks were performed at the same time in the experiment (prospective component), and participants had to remember three rules when performing the subtasks (retrospective component).

Participants were given the opportunity to form a plan to help them in the performance of this task. Plans were scored on the number of rules included in the plan, the number of times the participant specified a particular order for performing a subtask, and the number of executable items in the plan. An executable item was a specific detail about a step within the plan such as, "I will spend 30 seconds on this subtask." When compared to older adults, younger adults had more elaborate plans, were more likely to begin the prospective memory task at the appropriate time, and scored higher in their ability to carry out the subtasks by following the rules. Two recent studies provide evidence for the importance of planning in this same complex prospective memory task; regression analyses revealed that planning (as determined by the scoring method mentioned above) was a significant predictor of the ability to carry out this task successfully and explained most of the age-related variance in performance (Kliegel, Martin, & Moor, 2003; Martin, Kliegel, & McDaniel, 2003).

Although this complex prospective memory task was useful as an initial assessment of the role of planning in the performance of complex prospective memory tasks, there are three limitations to these studies. First, there needs to be a consideration of how the experimenters defined "complex." In this study, participants performed the six subtasks at the same time (prospective component) while needing to remember to follow certain rules (retrospective component). Although the retrospective component had three rules and may be considered complex, the prospective component (remember to perform the subtasks after answering a question) was similar to traditional measures of prospective memory such that it involved performing an intention after the presentation of a *single* cue.

Second, there is a question of how they defined planning. Similar to other planning studies, performance was mostly assessed by whether participants remembered the rules for performing the subtasks or the retrospective component of prospective memory (*what*) rather than the prospective component (*when*). Moreover, planning in this task consisted of developing a plan to remember the rules for the retrospective component as participants were not given the opportunity to develop retrieval cues to remember the prospective component (all participants had to begin the task at the same prospective memory cue and did not have the opportunity to choose a cue).

Third, this task was not a familiar task to participants and it would be difficult to draw conclusions about whether there are age-related differences in the performance of complex, familiar prospective memory tasks. The role of planning in a complex, familiar prospective memory task was investigated by Craik and Bialystok (in press). Participants engaged in a simulated cooking task in which they had to monitor the cooking of five different breakfast foods while concurrently participating in a simulated table setting task. The complexity of both components of prospective memory was manipulated such that each food had to be started at a different time (prospective component) with different rules for how long each food should cook (retrospective component). The overall goal of the task was to have all five foods ready to eat at the same time. For example, bacon might need to be cooked for 10 minutes whereas the toast only needed to be cooked for two and a half minutes. Participants would want to start cooking the toast after the bacon had been cooking for seven and a half minutes to have both foods ready at the same time. Planning ability was assessed by the difference between the time the first food finished cooking and the last food finished cooking.

Age-related differences in performance of the Craik and Bialystok (in press) task were observed and interpreted in terms of older adults' inability to plan to perform this task. However, the authors did not report a measure of how participants formed plans to perform this task or what retrieval cues they relied on in the performance of this task (i.e., plan development). Although they were not directly told to do so, participants were supposed to rely on the cooking times of other foods to serve as retrieval cues (when the eggs had been cooking for x amount of time then I need to start making the coffee). It could be the case that older adults developed similar plans to the younger adults, but were unable to implement these plans because they forgot them or were not able to follow them. Without an assessment of plan development, there is no way to know the locus of the age-related differences in performance (i.e., age-related differences in plan development, plan implementation, or both). Therefore, our understanding of the role of planning in the performance of familiar complex prospective memory tasks and its relationship to age is limited to plan implementation.

To summarize the relevant literature, investigations into age-related differences in the performance of prospective memory tasks have generated mixed findings. A source of the conflicting findings appears to be related to the type of cues available at retrieval, and the types of tasks used to investigate prospective memory such that some retrieval cues (e.g., event-based) and some tasks (e.g., familiar) provide more environmental support than others. However, little is known about how people of all ages establish their own retrieval cues in the performance of complex prospective memory tasks (i.e., how they plan to remember to perform these tasks). Therefore, there is an incomplete understanding of whether there are age-related differences in how people plan to remember to perform familiar, complex prospective memory tasks (i.e., plan development), their ability to implement their plans (i.e., plan implementation), and how planning influences their subsequent prospective memory performance.

Overview of the Current Study

The goal of the current study was to investigate age-related differences in the role of planning in the performance of complex prospective memory tasks. More specifically, participants' plan development and plan implementation were assessed in the performance of two tasks: a medication planning task and a group planning task during two simulated weeks. There were four research questions that motivated this study: (1) How do participants develop plans to remember to perform the tasks? (2) Can participants implement their plans? (3) How does plan development (i.e., planning style) relate to plan implementation? and (4) How does prospective memory performance compare across age groups, across planning components (i.e., plan development and plan implementation), and across prospective memory tasks?

Participants performed the prospective memory tasks within the context of two simulated weeks based on the activities they perform as part of their weekly routines. Individualized weeks were used rather than a standardized week to allow participants to take advantage of their routine ("*organizational framework*") when planning to remember the prospective memory tasks (Craik & Kerr, 1996). The methodological decision to assess performance through *simulated* weeks in participants' lives, rather than *actual* weeks was based on a need to exert control over the cues that participants use to accurately assess planning. Although this may somewhat limit the external validity of this study, control was deemed more important for this investigation.

For both prospective memory tasks, participants were given the opportunity to plan how they would remember to perform these tasks. Therefore, participants had the opportunity to establish their own retrieval cues for both the prospective component of prospective memory (*when* they will take the medication or when a group will be scheduled), and the retrospective component (they could create an external aid of their plan to help them remember *what* they are supposed to do). Due to the complexity of these prospective memory tasks, the goal of this study was to understand how people developed plans and carried out their plans *not* whether they could remember their plans. For this reason, participants' plans were available to them at all times.

The task of medication planning was selected for three reasons: (1) it is a complex prospective memory task because each medication could potentially have its own set of rules (e.g., some medications may be taken with food whereas others may not), (2) both the prospective and retrospective components of the task can be complex, and (3) it is a task that is familiar to most people. The group planning task was essentially the same task as the medication planning task, but participants were scheduling rooms to be used by several groups rather than remembering to take medications. Although the two tasks were matched for difficulty, it was hypothesized that the medication planning task would provide more environmental support than the group planning task because of its familiarity to participants (particularly older adults). Through their experiences taking medications, older adults may have developed effective retrieval cues to remember to take their medications that could be used for this task (e.g., take medications at four times during the day – breakfast, lunch, dinner, and bedtime).

Performance in this task was assessed by both quantitative and qualitative measures. The quantitative measures were the number and type of errors (e.g., omissions, commissions, rule breaks) made in the medication planning and group planning tasks. For the qualitative analysis, participants' plans were coded into qualitative categories depending on the type of retrieval cues they used to help them remember a task and the plan layout. For example, participants cues were coded into whether they were event-based (e.g., breakfast) or time-based (e.g., 9AM). The goal of the qualitative analysis was to group participants' plans into planning styles to understand whether there was a relationship between planning style and subsequent performance.

Participants also were engaged in an ongoing activity called the party attendance task. The goal of the party attendance task was to distract participants from holding the intention actively in their working memory. This ongoing activity was to remember whether people would attend an event, and was presented to participants as a one-back recognition task. Participants were told that this task was equally important to the medication planning and group planning tasks.

Based on the literature review and consistent with predictions for the model of environment support (Craik, 1986), the following hypotheses were proposed for this study. Due to age-related declines in processing resources, the performance of the older adults was predicted to be more dependent on their planning style than the performance of the younger adults. More specifically, older adults who used event-based cues (e.g., take the medication at lunch) would have superior performance to older adults who used time-based cues (e.g., take the medication at 2PM). Furthermore, those participants (both younger and older) with more planning experience as measured by the Planning Experience Questionnaire (PEQ) would make fewer errors than those participants with lower scores on the PEQ. Finally, age-related declines in performance (number of errors) were expected to be greatest for time-based cues during the group planning task, and smallest for the event-based cues during the medication planning task.

CHAPTER 2

METHOD

Participants

A total of 67 participants participated in this study (31 younger adults and 36 older adults). Younger adults were compensated either $40 for their time or were given course credit. Older adults were compensated $60 for their time. Eight of the participants – one younger adult and six older adults - were excluded for various reasons (see Appendix A for additional details). Therefore, 60 participants (30 younger adults and 30 older adults) completed the study and were included in the following analyses. The age range of the younger adults was 18-28 (M = 19.43, SD = 2.10). The age range of the older adults was 64-75 (M = 66.87, SD = 3.25).

Materials

Equipment

The participants performed the computer tasks on an IBM-compatible Intel Pentium Pro. Participants were seated approximately 18 inches from the monitor screen. E-Prime software was used to develop the program for the simulated week and collect the data on error rates (Schneider, Eschman, & Zuccolotto, 2002).

Demographics and Health Questionnaire and Abilities Tests

Participants were administered a demographics and health questionnaire. Chi-square analyses revealed that there were no age-related differences in gender (p=.80), in English as a primary language (p=.36), or in perceived health (p=.18) (see Table 1). However, there were age-related differences in ethnicity, $\chi^2(1, N = 60) = 21.58$, p<.01, and education, $\chi^2(1, N = 60) = 18.09$, $p<.01$ such that younger adults were more ethnically diverse than older adults and older adults were more educated than younger adults.

Table 1

Participant Demographics (Frequencies for Each Age Group)

	Younger Adults	Older Adults
Gender		
Female	13	16
Male	17	14
Ethnicity*		
African American	1	4
Asian	11	0
Caucasian	13	23
Hispanic	1	1
Multi-racial	2	0
Other	2	0
Did not answer	0	2
Education*		
High school	11	5
Vocational	0	1
Some college	17	8
Bachelor's	2	8
Post graduate training	0	8
English as primary language		
Yes	29	27
No	1	1
Did not answer	0	2
Perceived health		
Fair	1	2
Good	7	12
Very good	14	13
Excellent	8	2
Did not answer	0	1

*indicates a significant difference between the age groups at $p<.05$.

Four abilities tests were used to describe the participant population: the vocabulary subtest of the Shipley Institute of Living Scale (Shipley, 1986), the Digit Symbol Substitution (DSS) and Reverse Digit Span subtests of the WAIS-R (Wechsler, 1997), and the Automated Operation Span (Unsworth, Heitz, Schrock, & Engle, 2005). Younger adults outperformed older adults on the DSS, $t(60) = 9.09$, $p<.01$, $\eta^2 = .59$, the recall of the DSS, $t(60) = 4.78$, $p<.01$, $\eta^2 = .28$, and the Reverse Digit Span test, $t(60) = 5.25$, $p<.01$, $\eta^2 = .32$ (see Table 2). However, older adults outperformed younger adults on the vocabulary test $t(60) = -3.55$, $p<.01$, $\eta^2 = .18$. For the operation span, younger adults outperformed the older adults, $t(60) = 8.88$, $p<.01$, $\eta^2 = .58$.

Table 2

Participant Characteristics and Abilities

	Younger Adults		Older Adults	
	M	SD	*M*	SD
Abilities tests				
Digit symbol substitution total completed*	75.47	8.04	50.93	12.41
Recall of digit symbol substitution*	8.03	1.45	1.45	.27
Reverse digit span total score*	11.20	2.12	8.00	2.57
Shipley vocabulary total correct*	30.80	4.21	34.70	4.31
Automated operation span total correct*	64.50	8.37	32.93	17.51
Personality measures (self-ratings)				
Worrying*	4.33	1.47	3.03	1.33
Scale from 1 (never) to 6 (always)				
Preparedness				
Scale from 1 (never) to 6 (always)	4.30	.75	4.63	1.25
Well-organized	4.47	1.04	4.47	1.28
Scale from 1 (never) to 6 (always)				

*indicates a significant difference between the age groups at p<.05.

Two questions were included to provide a measure of neuroticism and conscientiousness as these two personality traits may influence participants' planning behaviors. These questions were adapted from items in the International Personality Item Pool (Goldberg et al., 2006). On a scale from 1 to 6, participants were asked to rate whether they worry about things (neuroticism) and whether they were always prepared (conscientiousness). Younger adults reporting worrying about things more often than older adults, $t(60) = 3.60$, $p<.01$, $\eta^2 = .18$; however, there were no age-related differences in participants' self-reported preparation ($p=.21$; see Table 2). In addition to personality traits, level of organization also was deemed as potentially important for planning. On a scale from 1 to 6, participants were asked to rate their level of organization. There were no age-related differences in how well-organized participants rated themselves ($p<1.00$).

Familiarity with Task Domains

Familiarity with the task domains was considered important for the planning tasks because someone who was familiar with the tasks may have greater knowledge of effective cues to aid prospective memory performance. Older adults had more experience taking medication than younger adults, $\chi^2(1, N=60) = 15.43$, $p<.01$, and more experience scheduling groups to meet in rooms than younger adults, $\chi^2(1, N=60) = 9.10$, $p<.01$ (see Table 3). Within an age group, younger adults did not differ in their experience levels between the task types ($p=.14$) whereas older adults reported significantly more experience with medications than scheduling groups, $\chi^2(1, N=60) = 9.95$, $p<.01$.

Table 3

Frequency of Task Experience for Both Task Types

	Experience Taking Medications*		Experience Scheduling Groups*	
	Younger	*Older*	*Younger*	*Older*
Yes	10	25	5	15
No	20	3	25	14
No Answer	0	2	0	1

*indicates a significant difference between the age groups at p<.05.

Older adults ($M=3.61$, $SD=2.71$) also reported taking significantly more medications than younger adults ($M=.77$, $SD=1.07$), $t(60) = -4.59$, $p<.01$, $\eta^2 = .27$, as well as more experience taking medications that must be taken at different times, $\chi^2(1, N=60) = 16.76$, $p<.01$ (see Table 4). However, there were no age-related differences in whether participants were primarily responsible for managing their medications ($p=.58$).

Participants also were asked whether they had any health conditions such as diabetes. During pilot testing, it was observed that one participant who had diabetes had an advantage over other participants because he had experience planning his daily activities around his insulin shots. There were no age-related differences in asthma ($p=.13$) and epilepsy ($p=.25$) (see Table 4). However, when compared to younger adults, more older adults reported having diabetes, $\chi^2(1, N = 60) = 9.23$, $p=.03$, arthritis, $\chi^2(1, N = 60) = 23.72$, $p<.01$, cancer, $\chi^2(1, N = 60) = 12.00$, $p<.01$, heart disease, $\chi^2(1, N = 60) = 20.00$, $p<.01$, and hypertension, $\chi^2(1, N = 60) = 18.26$, $p<.01$. Therefore, older adults did have more experience managing chronic illnesses than younger adults.

Table 4

Frequencies of Experience for Medication and Preexisting Conditions

	Younger Adults	Older Adults
Experience taking medications at different times*	1	12
Primary responsibility for medication management	28	26
Preexisting conditions		
Arthritis*	0	16
Asthma	9	9
Cancer*	0	8
Diabetes*	0	6
Epilepsy	0	0
Heart disease*	0	14
Hypertension*	0	12

*indicates a significant difference between the age groups at $p<.05$.

Planning Experience Questionnaire (PEQ)

The PEQ was used to assess planning experience in participants' everyday lives (see Appendix B). The planning experience questionnaire consisted of five questions in each of the following five domains: work/volunteering, finance, health, social, and entertainment. Five different domains were selected because participants may plan more in some domains than others. Participants were given a statement, "I plan ahead to make sure that I attend my appointments." Participants were then given a Likert scale ranging from 1 (never) to 6 (always). The range of the scale was selected to discourage participants from selecting the middle value each time. The maximum score for each domain was 30 and the maximum total score was 150.

Table 5

Planning Experience Scores for Both Age Groups

	Younger Adults		Older Adults	
	M	SD	*M*	SD
Work*	19.37	3.89	22.27	4.52
Finance*	12.20	5.59	18.23	8.34
Health*	14.47	6.08	21.13	6.02
Social	13.60	5.11	13.17	5.60
Entertainment	16.83	5.39	15.33	7.72
Total score*	76.47	19.10	90.13	24.48

*indicates a significant difference between the age groups at $p<.05$.
Note: Scale was from 1 (never) to 6 (always) for all domains.
Note: Scores for the five domains were calculated based on the total score for each domain (max=30). The total score was calculated based on the score for all domains (max=150).

Participants reported using planning strategies relatively frequently (see Table 5). There were age-related differences in how often participants reported using planning strategies in their everyday lives with older adults reporting the use of planning strategies significantly more often than younger adults, $t(60) = -2.41$, $p=.02$, $\eta^2= .09$. Furthermore, there were age-related differences within domains. More specifically, older adults reported using significantly more planning strategies for work, $t(60) = -2.66$, $p<.01$, $\eta^2 = .11$, finance $t(60) = -3.29$, $p<.01$, $\eta^2 = .16$, and health, $t(60) = -4.27$, $p<.01$, $\eta^2 = .24$, but there were no age-related differences in the use of strategies to remember social obligations ($p=.76$) or entertainment ($p=.39$).

Weekly Routine Interview

The weekly routine interview was administered over the telephone. Participants were asked about the typical activities they perform hour-by-hour, day-by-day as part of their weekly routine. This information was used to simulate a week in the participant's lives. The instructions to participants were as follows: "We would like to get a sense of the activities that you perform each week as part of your weekly routine. We are trying to set up a situation to mimic your everyday activities when you come into the lab. We are concerned about potentially offending people. If I ask you a question that you don't want to answer, please tell me it's none of my business or that you'd rather not tell me. I appreciate your patience because I am required to ask you a list of very specific questions. Please be patient with me and answer the questions as accurately as you can."

In the exit interview, participants were asked if it was difficult for them to answer questions about their weekly routine. A chi-square analysis revealed that there were no age-related differences in self-reported difficulty completing the phone interview, $\chi^2(1, N = 60) = 2.61$, $p=.27$. Participants also were asked, "How structured is your daily routine?" and "How structured is your weekly routine?" They were presented with a Likert scale ranging from 1 (very unstructured) to 6 (very structured). There were no age-related differences in level of daily routine structure (p=.11) or level of weekly routine structure (p=.17).

The days were from Monday-Sunday, and the hours ranged from 7AM-12 midnight. The days were presented from Monday-Sunday rather than other variations (e.g., Sunday-Saturday) to keep both weekend days together since a person's routine may vary from week days to the weekend. For each hour, participants were asked two questions: (1) What activity do you do at that time?, and (2) Can you give me any details about that activity? For example, a participant may indicate that she eats breakfast at 9AM on Mondays and the detail about breakfast is that she usually eats cornflakes and milk. Participants were not asked to provide any details about sleeping or physical maintenance activities (e.g., showering). Appendix C includes two routines reported by a younger and older adult.

Computer Mouse Training

To take a medication or schedule a group, participants needed to position a computer mouse over an interface with boxes labeled for the different medications and groups. Participants were given training using the mouse before the experimental session to ensure that no one was at a disadvantage due to lack of experience using a computer mouse. Participants were given the mouse training on both days of the experiment.

The interface for the mouse training exercise was the same as the one for the experimental exercise except that the boxes were given a generic label (e.g., "Box 1") instead of the specific labels for the tasks (e.g., "Medication 1"). The mouse training exercise consisted of 40 trials in which participants had to select each box six times (some trials involved the selection of multiple boxes) and then select the Submit button.

Participants' performance on the mouse training exercise was assessed by the number of errors (i.e., number of times that an incorrect box was selected) and the number of times that participants clicked the mouse button (i.e., mouse clicks).

Participants were given three opportunities to score at least 90% to pass the mouse training. The number of mouse clicks was measured because it was thought to provide a measurement of how much difficulty participants had interacting with the mouse such that more mouse clicks would mean more difficulty controlling the mouse and selecting the correct box. The time to complete the mouse training tasks was not measured because participants could work at their own pace during both the mouse training and the experimental session.

All participants passed the mouse training exercise and there were no age-related differences in number of errors made during mouse training (p=.09). However, younger adults made significantly more mouse clicks than older adults during mouse training, $t(60) = 4.08$, $p<.01$, $\eta^2 = .22$, but it does not appear that they had more difficulty using the mouse as they made fewer errors than older adults (although this difference was not significant). Overall, the findings from the mouse training exercise suggest that there were no age-related differences in the use of a computer mouse for this study and all participants were capable of making the mouse movements necessary to perform the experimental tasks.

Prospective Memory Tasks

Participants participated in two simulated weeks, and they had to remember to perform a prospective memory task during each week. The two prospective memory tasks were medication planning and group planning, the different subtasks for both tasks were presented in the same order, but the order of the task presentation was counterbalanced. Participants were informed they would be participating in a pretend week based on the information they provided during the weekly routine interview, and the week would begin with Monday at 7AM and end on Sunday at 12 midnight.

Participants were given a sheet of paper with information about eight different medications or eight different groups that varied in their level of complexity. The complexity of the tasks was manipulated on three dimensions (see Table 6): (1) whether the prospective memory task had to be done everyday (i.e., whether it could be incorporated as part of their daily routine), the number of times it needed to be done, and whether there was a specific rule regarding when it could be done. The decision to manipulate whether the prospective memory task was part of their daily routine was made because of evidence that older adults plan prospective memory tasks around their daily activities (Gould, McDonald-Miszczak, & King, 1997; Loewen, Shaw, & Craik, 1990).

The instructions for both the medication planning and the group planning tasks were identical such that participants were told that (1) multiple medications/groups could be taken at the same time and there was no limit to the number of medications that could be taken at the same time, (2) medications/groups could be taken anytime between 7AM-12 midnight as long as none of the medications/groups had any rules about when they could be taken, and (3) they would not need to memorize this information because it would always be available to them. Participants were asked whether they noticed any similarities between the two tasks and what those similarities were. The majority of participants noticed some similarities between the two tasks, but there were no age-related differences in noticing similarities, $\chi^2(1, N = 60) = 2.97$, $p=.23$.

Participants were informed that they had up to 30 minutes to develop a plan to help them remember when they would take their medications (or schedule their groups) during the pretend week. They were told that they did not need to use all 30 minutes to develop their plans and they would be told when 20 minutes had passed. Participants were provided with unlined paper and sticky notes and informed that they could use these materials in any way that they wanted to help them develop their plans. Participants were told that they did not need to memorize their plans because they would be available to them during the pretend week.

When participants provided their plans they were not corrected for comprehension mistakes. Errors in comprehension were measured as plan accuracy which was part of plan development. Instructions for both planning tasks were purposefully vague to see how people developed plans based on the information they were given. For example, if participants asked how long a group should meet, the response was, “You decide how long the group should meet because you are scheduling the meeting.”

Table 6

Requirements by Routine, Number of Times, and Whether There was a Rule

	One time	Multiple times
Routine (Rule)	Medication 5: Take one pill each day (Monday through Sunday). Pills should not be taken with food.	Medication 1: Take three pills each day at different times of the day (Monday through Sunday). Pills should not be taken in the evening (after 6PM).
	Group E would like to meet each day (Monday through Sunday). The meeting time cannot be during your mealtime.	Group A would like to have three separate meetings each day (Monday through Sunday). No one can meet in the morning (before 12PM).
Routine (No rule)	Medication 2: Take one pill each day (Monday through Sunday).	Medication 6: Take three pills at different times of the day each day (Monday through Sunday).
	Group B would like to meet each day (Monday through Sunday).	Group F would like to have three separate meetings each day (Monday through Sunday).
Non-routine (Rule)	Medication 4: Take one pill on one day during the week (Monday through Sunday). Pills should not be taken in the morning (before 12PM).	Medication 8: Take one pill on three different days during the week (Monday through Sunday). Pills should not be taken with food.
	Group D would like to meet on one day during the week (Monday through Sunday). No one can meet in the evening (after 6PM).	Group H would like to meet on three different days during the week (Monday through Sunday). The meeting time cannot be during your mealtime.
Non-routine (No rule)	Medication 7: Take one pill on one day during the week (Monday through Sunday).	Medication 3: Take one pill on three different days during the week (Monday through Sunday).
	Group G would like to meet on one day during the week (Monday through Sunday).	Group C would like to meet on three different days during the week (Monday through Sunday).

Planning Interview

To assess planning for both tasks, participants were asked for each medication and each group: (1) When will you take this medication? or (2) When will this group meet? Participants were informed that once they indicated when a medication would be taken or a group would meet that they could not make any changes during the week. If participants mentioned that they would rely on an event that they failed to mention in their weekly routine interviews then this event was added to their routine as a cue. Although the weekly routine interview was designed to capture the majority of a person's schedule, cues sometimes had to be added if a participant indicated that he or she would rely on those cues to remember either prospective memory task. For example, if a participant mentioned that he or she would take medication two during lunch on Tuesday, but did not mention when they would have lunch on Tuesday, they were asked when they would have lunch and the word "lunch" was entered into their routine. Also, if participants mentioned that they would perform the prospective memory task during an event that lasted several hours then they were asked the specific time that they would perform the prospective memory task.

Simulated Week Program

Each participant's activities were entered into a Microsoft Excel spreadsheet where a macro created a list of their activities for each day and each hour of the day. The simulated week was then pasted into the E-prime program. For each hour in the day, the program displayed the day of the week, the activity (e.g., breakfast), any details about the activity (e.g., cornflakes and milk), and information about whether someone was attending the event (the party attendance task). Participants could access the time by pressing the “t” key.

Party Attendance Task

The party attendance task was an ongoing task that resembled a 1-back recognition task. The n-back task requires participants to repeat the nth item back (e.g. 0-back, 1-back, 2-back) in a sequentially presented list of items (Dobbs & Rule, 1989; Li & Sikström, 2002). Difficulty of the task was manipulated by requiring the participants to remember items further back in the list. In this study, participants kept track of whether someone would attend an event (Yes, No, or Maybe). For each hour of the day, they received information about someone’s last name and their RSVP status (e.g., Smith, Yes). If the task were a 0-back, participants would immediately be prompted to indicate the RSVP status of the person they received information about. In other words, participants would receive information that Smith will attend (Smith, Yes) and then on the next screen participants would be asked about Smith’s RSVP status. The party attendance task was a one-back which means that there was an intervening hour in which participants received information about another person’s RSVP status (e.g., Johnson, No). Then the next screen prompted participants for Smith’s RSVP status (see Figure 1).

To answer the questions for the party attendance, participants pressed the “y” key (yes), the “n” (no) key, and the “m” (maybe) key on the keyboard. Participants were not explicitly encouraged to engage in any strategies for the 1-back recognition task. The decision to use last names instead of first names was made because first names can vary by cohort. The names included in this task were accessed on a website listing the 1000 most common names currently in the United States based on the 1990 US Census (http://names.mongabay.com/most_common_surnames.htm.) The order of the names was randomly distributed throughout the task (Smith was the most common name, but was not the first name seen by participants) and each participant was given the names in the same order.

Instructions to participants for the ongoing task were as follows: "You are a member of an organization that is sponsoring an event. You are responsible for keeping track of whether people will be attending the event (Yes), will not be attending the event (No), or might be attending the event (Maybe). For each hour of the pretend week, you will receive information about a person and their response – for example, Smith and Yes. An hour of your week will go by and then you will receive information about another person's RSVP status (e.g., Johnson, No). Then the next screen will ask you for Smith's RSVP status." Participants were given the opportunity to practice this task to make sure they understood the instructions.

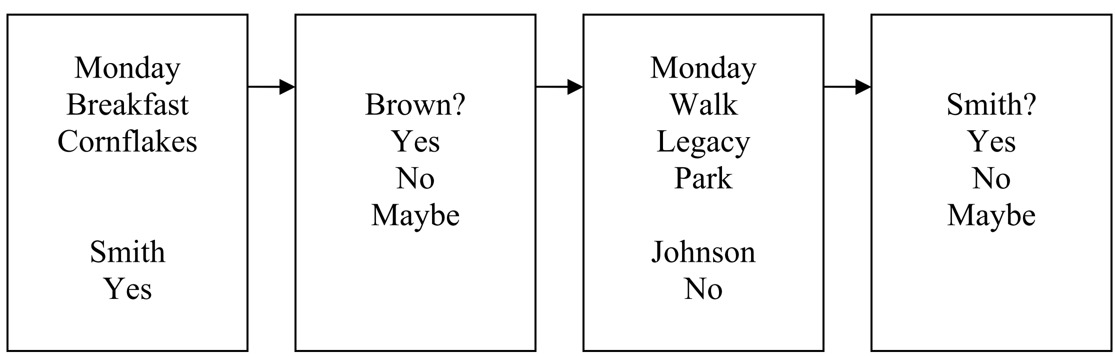


Figure 1. Screen displays to demonstrate how the party attendance task was presented to participants. Brown's RSVP status would have been on the screen prior to the "Smith Yes" screen.

Participants were told that this task was equally important to the medication planning and group planning tasks. Instructions to participants were as follows: "You should devote half of your attention to the planning task (medication or group) and half of your attention to the RSVP task. In other words, both tasks are equally important and you should give both tasks the same amount of attention."

Experimental Training Session

Participants were trained on all aspects of the experimental procedure before they participated in the pretend weeks. The practice session lasted approximately 20 to 30 minutes and participants engaged in the practice session before each simulated week. Participants practiced checking the time, selecting boxes to take their medications or schedule groups, answering responses for the party attendance task, and both tasks at the same time. Participants were asked questions to ensure that they understood the directions for the study such as what keys to press to check the time, take their medications or schedule a group, the party attendance task, the directions for the party attendance task, how their performance would be scored, and how to recover from an error if they made one.

Scoring

Before participants began the pretend week, they were informed about how their performance would be scored. Participants were told that the party attendance task and the planning tasks were equally important and that they would lose the *most* points if they forgot to do something, did something at the wrong time, or put the wrong response for people attending the party. Participants were also told that they would lose *some* points for pressing the "t" key to check the time.

The decision to penalize participants for *some* points if they pressed the "t" key was based on pilot testing. Some participants would press the "t" key on almost every trial if there was no penalty for pressing the “t” key (96 out of 126 trials); on the other hand, participants would avoid pressing the “t” key the entire experiment if they lost the same amount of points as forgetting something or doing something at the wrong time. The wording for “some points” was selected as a compromise because although there was concern about inhibiting what participants would do in their everyday lives (e.g., check their watch or a clock), checking the time often can be distracting and there needed to be some measure of cost with pressing the “t” key. Furthermore, participants did have time-based information available to them because time was linked to participants’ specific activities provided in their weekly routine.

Exit Interview

The exit interview was designed to assess participants’ perceptions of the medication planning task, the group planning task, and the party attendance task. Participants were asked to compare how much attention they devoted to the prospective memory task when compared with the party attendance task and which one of these tasks was more important. The exit interview also was designed to assess how structured participants’ daily routines were and to give them an opportunity to indicate if they had a very structured daily or weekly routine. In addition, the medication planning task and group planning task were virtually identical tasks framed in terms of different contexts, and there was a question in the exit interview about whether participants noticed any similarities between the two tasks.

Procedure

This study was conducted over two sessions with the weekly routine interview in the middle of the two experimental sessions. The first experimental session was a group session and the second session was conducted individually. The total time to complete the experiment was approximately four hours for younger adults and six hours for older adults. Each participant needed to complete his or her participation within one month and participants had to complete the second session within two weeks of answering the weekly routine interview to control for the any changes to the weekly routine interview.

For session one, participants signed the informed consent, completed the demographics and health questionnaire, and the planning experience questionnaire. After completing the questionnaires, participants were given the digit symbol substitution, the reverse digit span, and the Shipley vocabulary tests. Then participants engaged in the mouse training exercise and completed the Automated Operation Span. The Automated Operation Span was administered last to participants because it was very demanding to older adults during pilot testing and there was some concern about their level of fatigue after completing this measure.

For session two, participants were given either the group planning task or the medication planning task depending on which counterbalance condition they were placed in. Participants then had the opportunity to plan how to remember this task, and were interviewed about when they planned to take each medication or schedule each group. Participants then participated in a simulated week based on the weekly routine interview augmented by specific events mentioned in their plans. Participants then completed the experimental practice session to ensure that they understand the instructions for both the prospective memory task and the ongoing task. Then participants led themselves through a simulated week in their lives while remembering to perform the prospective memory task. Participants were then given a short break followed by the second prospective memory task. They completed their plans for this task, a practice session for this task, and led themselves through another simulated week. After completing the second simulated week, participants completed the exit interview.

Lastly, participants were debriefed. Given the difficulty of the tasks, participants were told during the debriefing, “This was a very difficult study that you participated in today. We were trying to see what people are capable of and designed these tasks to be as difficult as we could make them. Please do not feel frustrated if you did not remember all that you had intended to remember. Our ultimate goal is to be able to help people to better remember activities they have planned.”

CHAPTER 3

RESULTS

The results have been divided into three sections based on the primary research questions: (1) how did participants develop plans to remember to perform the tasks? (i.e., plan development), (2) could participants implement their plans? (i.e., plan implementation), and (3) was there a relationship between plan development and plan implementation?

The fourth research question was whether the type of task or age of the participant would influence plan development, plan implementation, or the relationship between the two. A mixed between-within ANOVA was employed to explore the impact of task and age on a continuous dependent variable unless otherwise indicated. For all analyses to explore the impact of task and age on a categorical dependent variable, chi-square analyses were employed unless otherwise indicated.

Plan Development

Participants' plan development was assessed on both quantitative and qualitative dimensions. The quantitative dimensions were time to develop the plan, the accuracy of the plan, and the efficiency of the plan (see Table 7). The qualitative dimensions were type of retrieval cue, plan layout, and planning style.

Quantitative Analysis of Plan Development

Time to develop plans. All participants completed their plans within the 30 minute time limit (see Table 7). They spent more time developing their plans for the group planning task than the medication planning task as evidenced by a marginally significant main effect for task type, $F(1,60)=3.77$, $p=.06$, $\eta_p^2= .06$. Younger adults developed their plans more quickly than older adults as evidenced by a main effect of age, $F(1,60)=20.72$, $p<.01$, $\eta_p^2=.90$, but there was no interaction between task type and age group on time to develop plans ($p=.23$).

Table 7

Quantitative Analysis of Plans

	Younger Adults		Older Adults	
	M	SD	*M*	SD
Medication planning task				
Time to develop plan*[a]	10:34	5:27	17:40	7:35
Plan accuracy[b]	7.43	.82	7.17	1.09
Prospective instances[c]	18.03	6.90	23.70	7.97
Group planning task				
Time to develop plan*[a]	14:03	7:41	18.24	7:10
Plan accuracy[b]	7.43	.90	7.27	.83
Prospective instances[c]	21.37	9.57	22.37	9.69

*indicates a significant difference between the age groups at p<.05.
[a] minutes:seconds (max time=30 minutes)
[b] accuracy was scored on number of medications/groups out of eight correctly placed within the plan (max score=8)
[c] prospective instances were when participants had to remember to either take a medication or a group meeting (max score=64)

Accuracy of Plans. A score for plan accuracy was calculated based on the number of medications/groups out of eight that participants correctly placed within their plans. The mean score for both age groups was over seven for both tasks providing evidence that participants comprehended the instructions for the prospective memory tasks (see Table 7) as reflected in the accuracy of their plans. In addition, there was no main effect for age group ($p=.23$), task type ($p=.76$), or an interaction for age group and task type ($p=.76$). Thus both age groups comprehended the instructions for both prospective memory tasks.

Number of prospective instances. Participants' plans were evaluated on the number of prospective instances included in the plan. A prospective instance was when participants had to remember to either take a medication or a group meeting. The requirements of the tasks yielded 64 potential prospective instances in which a medication or a group had to be remembered (see Table 7). However, participants could reduce the number of prospective instances by taking multiple medications or scheduling multiple groups for a single trial (hour) or within consecutive trials (hours). The number of prospective instances could be considered a measure of plan efficiency because plans with fewer prospective instances should require fewer demands on processing resources. Most participants were relatively efficient in their plan development as indicated by having significantly fewer than 64 prospective instances in their plans for both tasks. A t-test was calculated to assess that directly for both the medication planning task, $t(60) = -42.17$, $p<.01$, $\eta^2= .97$, and the group planning task, $t(60) = -34.13$, $p<.01$, $\eta^2= .95$, and all participants' plans contained prospective instances much less than 64.

There was no overall difference in the number of prospective instances by the type of task (p=.46). However, younger adults had fewer prospective instances in their plans than older adults especially for the medication planning task as evidenced by a main effect for age on number of prospective instances, $F(1,60)=3.52$, $p=.07$, $\eta_p^2=.06$, and a marginally significant interaction effect (p=.09).

Summary of quantitative analysis of plans. All participants developed their plans within the time limit, but they spent more time developing their plans for the group planning task than the medication planning task. Both age groups were quite accurate in developing their plans for both prospective memory tasks although older adults were slower and had more prospective instances in their plans than younger adults. Thus, at least at the quantitative level, participants could develop plans, but a qualitative analysis was necessary to learn what kinds of plans they developed.

Qualitative Analysis of Plan Development

A qualitative coding scheme was developed to code participants' strategies on type of cue, plan layout, and planning style (see Appendix D for the rules for coding participants' plans). Two coders independently coded participants' responses into the categories, and inter-rater reliability was computed for each question.

Type of cue. Participants' plans were coded for the types of cues used according to whether they were event-based (e.g., lunch), time-based (e.g., 3PM), or a mix between the two (inter-rater reliability = .95). In some cases, participants did not specify a particular event in their plans, but chose time-based cues normally associated with certain events in their routine such as 9AM (breakfast), 12PM (lunch) and 6PM (dinner). The assumption is that the participant was using these times to cue certain events although he or she did not verbally express this to the researcher and these cues were coded as mixed.

As is evident in Table 8, participants used time-based cues most frequently followed by mixed cues and event-based cues for the medication planning task. There were no age-related differences in the types of cues used for the medication planning task (p=.37). Participants used time-based cues most frequently for the group planning task followed by equal numbers of mixed cues and event-based cues. There were no age-related differences in the types of cues used for the group planning task (p<1.00). However, there was a significant different when the cues used for the two tasks were compared, $\chi^2(1, N = 120) = 13.89$, p<.01. The pattern in the data is such that participants used more time-based cues for the group planning task than the medication planning task and more mixed-based cues for the medication planning task than the group planning task.

Table 8

Qualitative Plan Dimensions (Frequencies for Each Age Group)

	Younger Adults	Older Adults	Total
Type of cue			
Medication planning task			
Time-based	21	19	40
Event-based	1	4	5
Mix of event and time	8	7	15
Group planning task			
Time-based	28	28	56
Event-based	1	1	2
Mix of event and time	1	1	2
Plan layout			
Medication planning task*			
Chart	21	12	33
List	6	16	22
Mix of chart and list	3	0	3
Group planning task*			
Chart	21	14	35
List	7	14	21
Mix of chart and list	2	2	4

*indicates a significant difference between the age groups at $p<.05$.

Plan layout. Participants' plan layouts were coded within three categories according to whether they developed a chart, a list, or both a chart and a list (inter-rater reliability=.91). (Note: two older adults' plan layouts were missing for the medication planning task and could not be included in the analysis.) Participants used a chart layout most frequently followed by a list layout and a mix layout.

In general, participants' plan layouts did not differ significantly depending on the type of task (p=.53). However, there were age-related differences in plan layout depending on the type of task. Although there were no age-relation in plan layout for the group planning task (p=.16), there were age-related in plan layout for the medication planning task, $\chi^2(1, N = 58) = 12.00$, p<.01. The majority of younger adults developed a chart for the medication planning task whereas older adults were equally split on the use of either a chart or a list to help them remember.

Planning style. Participants' plans were categorized according to the combination of type of cue and plan layout to understand the overall planning style that participants adopted to approach a task. Participants' planning styles were coded into four categories: (1) chart layout/event-based cue, (2) chart layout/time-based cue, (3) list layout/event-based cue, and (4) list layout/time-based cue (see Appendix E for examples from each style for each age group). To reduce the number of categories, mixed plan layouts and mixed cues were re-coded as chart for plan layout and event-based for cue type. This re-coding was based on the fact that the development of a chart and the use of an event-based cue required the planner to re-conceptualize the planning activity because the medications/groups were presented in a list to the participants and with time-based information (i.e., participants were told that their week would be presented to them hour-by-hour). In addition, a participant's plan layout was coded as a chart even if they also had a list because of the observation that participants started with a list, converted this list to a chart, and primarily relied on the chart during the experimental session.

The most frequently used planning style for both tasks was the chart layout/time-based cue planning style followed by the use of the list layout/time-based cue, the chart layout/event-based cue, and the list layout/event-based cue (see Table 9). There were no age-related differences in planning style for the group planning task (p=.25), but there were age-related differences in planning style for the medication planning task, $\chi^2(1, N = 58) = 9.83$, p=.02. Younger adults were more likely to use a chart layout/time-based planning style whereas older adults were more likely to use a list layout/time-based planning style. Type of task did influence planning styles, $\chi^2(1, N = 118) = 14.30$, p<.01, such that participants were much more likely to use a chart layout/event-based planning style for the medication planning task and a chart layout/time-based planning style for the group planning task.

Table 9

Planning Styles for Both Tasks

	Medication Planning		Group Planning		Total	Total %
Planning Style	*Younger*	*Older*	*Younger*	*Older*		
Chart layout/Time-based	17	6	21	15	59	50.00%
List layout/Time-based	4	11	7	13	35	29.66%
Chart layout/Event-based	7	6	2	1	16	13.56%
List layout/Event-based	2	5	0	1	8	6.78%
Total	30	28	30	30	118	100%

There was also an age-related difference in whether participants adopted the same planning style for both tasks (see Table 10). The majority of younger adults (73%) were more likely to use the same planning style for both tasks whereas half of the older adults used different planning styles for the two tasks. Therefore, the planning style adopted by the older adults was more dependent on the type of task than the planning style selected by the younger adults.

Table 10

Planning Styles Across Both Task Types

	Group Planning Styles				
	Chart/Time	*List/Time*	*Chart/Event*	*List/Event*	*Total*
Medication planning styles					
Younger adults					
Chart/Time	**16**	1	0	0	17
List/Time	0	**4**	0	0	4
Chart/Event	5	0	**2**	0	7
List/Event	0	2	0	0	2
Older adults					
Chart/Time	**5**	1	0	0	6
List/Time	4	**7**	0	0	11
Chart/Event	5	0	**1**	0	6
List/Event	0	4	0	**1**	5
Total	35	19	3	1	58

Summary of qualitative analysis of plans. To assess plan development, participants' strategies were coded into qualitative categories based on the type of retrieval cue, type of plan layout, and a category that combined both into a single planning style. Participants used time-based cues most frequently for both tasks, they used time-based cues more frequently for the group planning task than the medication planning task, but there were no age-related differences in the cues selected. For plan layout, participants used the chart layout most frequently for both tasks followed by the list layout; a mixed layout was used infrequently. There were age-related differences in plan layout for the medication planning task such that younger adults were more likely to use the chart layout whereas older adults were split between the chart and the list layouts.

These findings provide evidence that type of task influenced the selection of retrieval cues; in contrast, the age of the participant was related to the plan layout selected.

However, when participant' plans were combined into planning styles, both type of task and age effects were found. There were age-related differences in the type of planning style selected only for the medication planning task. Younger adults were more likely to adopt a chart layout/time-based planning style whereas older adults were more likely to utilize a list layout/time-based planning style. However, a further analysis of planning style provides evidence that younger adults adopted the same planning style for both tasks whereas older adults adjusted their planning style based on the type of task.

Plan Implementation

Plan implementation was assessed by calculating the number of errors made by participants as they completed the simulated week. Error rates were calculated based on number of omission errors (forget to take a medication or forget a group meeting), commission errors (take a medication at the wrong time or indicate a group meeting at the wrong time), rule breaks (break a rule regarding food or time when taking a medication or scheduling a group), time counter presses (press the "t" key to check the time), and errors made on the party attendance task.

In the initial analyses, it was observed that errors were sometimes counted twice when a participant did not do the prospective memory task during the exact trial/hour they indicated in their plan, but did so two hours/trials later. An omission error was counted in the first case and a commission error was counted in the second case. It could be argued that this was not a good measure of prospective measure performance because the participant was penalized twice when they did not completely forget the prospective memory task. However, there is a difference between remembering the prospective memory task *two* hours later and *twelve* hours later. Therefore, a more flexible scoring system needed to be established with a reasonable cutoff point. This scoring method is analogous to scoring systems for other prospective memory studies (Einstein et al., 1995; Einstein & McDaniel, 1990). The cutoff point of three hours/trials was selected because the design of the study encouraged participants to rely on their routines to serve as time-based cues. Participants may classify certain activities in terms of morning, afternoon, and evening rather than a specific hour, and this scoring method provided them with some leeway to accommodate the prospective tasks within their routine.

Error Rates by Age Group and Task Type

The error rates for this analysis were combined into two categories: (1) prospective cost and total cost. Prospective cost errors were omissions, commissions, rule breaks, and time counter presses. Total cost errors were prospective cost errors plus party attendance errors. These data are presented in Table 11.

For prospective cost, participants pressed the time counter most frequently followed by omission errors, commission errors, and rule breaks. When compared to younger adults, older adults made significantly more omissions errors, $F(1,60)=9.24$, $p<.01$, $\eta_p^2=.14$, commission errors, $F(1,60)=8.96$, $p<.01$, $\eta_p^2=.13$, and time counter presses, $F(1,60)=5.37$, $p<.01$, $\eta_p^2=.09$, but there were no age-related differences in rule breaks ($p=.50$). However, the overall distribution of these errors was similar for both age groups and as a result these error types were summed together as a measure of prospective cost (see Figure 2 for percentage of prospective cost errors for the medication planning task for both age groups; the pattern was similar for the group planning task).

Figure 2. Percentage of prospective cost errors for the medication planning task

Older adults made more prospective cost errors than younger adults as evidenced by a main effect of age group, $F(1,60)=17.99$, $p<.01$, $\eta_p^2=.24$. Participants also made significantly more prospective cost errors during the group planning task as compared to the medication planning task as evidenced by a main effect of task type, $F(1,60)=12.77$, $p<.01$, $\eta_p^2=.18$. There was no significant interaction effect of age group and task type on number of prospective cost errors ($p=.46$).

Older adults also made significantly more total cost errors than younger adults as evidenced by a main effect of age group, $F(1,60)=51.99$, $p<.01$, $\eta_p^2=.47$. Participants also made significantly more total cost errors for the group planning task than the medication planning task as evidenced by a main effect of task type, $F(1,60)=6.87$, $p=.01$, $\eta_p^2=.11$. There was no significant interaction effect of age group and task type on number of total cost errors ($p=.65$).

Table 11

Error Rates by Age Group and Task Type

	Younger Adults		Older Adults	
	M	SD	*M*	SD
Prospective cost*[a]				
Medication planning	20.53	14.06	46.30	37.81
Group planning	26.17	14.71	57.37	34.49
Total cost*[b]				
Medication planning	34.13	22.46	94.97	45.19
Group planning	41.60	23.71	105.57	45.80

*indicates a significant difference between the age groups at p<.05.
[a] Prospective cost includes omission errors, commission errors, rule break errors, and time counter presses.
[b] Total cost includes prospective cost + party attendance errors.

Error Rates by Counterbalance Condition

The prospective memory tasks were counterbalanced such that half of the participants received the medication planning task before the group planning task and the other half of the participants received the group planning task followed by the medication planning task. An analysis was conducted to determine whether participants demonstrated performance improvements on the second task that they received. Although older adults made significantly more prospective cost errors than younger adults during the medication planning task, $F(1,60)=11.93$, $p<.01$, $\eta_p^2=.18$, counterbalance condition did not have an effect on prospective cost errors made for the medication planning task ($p=.49$) and there was no interaction effect ($p=.80$). Likewise, older adults made significantly more prospective cost errors than younger adults during the group planning task, $F(1,60)=20.83$, $p<.01$, $\eta_p^2=.27$, but counterbalance condition did not have an effect on prospective cost errors made for the group planning task (p=.15) and there was no interaction effect ($p=.93$).

Similarly, older adults made significantly more total cost errors than younger adults for both tasks as evidenced by a main effect of age for the medication planning task, $F(1,60)=5.42$, $p<.01$, $\eta_p^2=.09$, and the group planning task, $F(1,60)=53.66$, $p<.01$, $\eta_p^2=.49$. In addition, counterbalance condition did not have a significant effect on the number of total cost errors made during the group planning task ($p=.71$). However, participants made fewer total cost errors on the medication planning task when they performed this task after the group planning task as evidenced by a main effect of counterbalance condition, $F(1,60)=5.42$, $p=.02$, $\eta_p^2=.09$. This finding provides evidence that participants' performance for the medication planning task benefited from the experience of first performing the group planning task. There was no significant interaction effect of age group and counterbalance condition for either the group planning task ($p=.26$) or the medication planning task ($p=.49$).

Error Rates by Complexity Manipulations

The complexity of the eight subtasks within the prospective memory tasks were manipulated in three ways: (1) whether the medication/group had a rule, (2) whether the medication/group had to be remembered everyday, and (3) the number of times that the medication/group had to be remembered (see Table 6).

Table 12 displays the number of errors made by participants depending on whether the subtask contained a rule. It was hypothesized that there would be fewer prospective memory errors (omissions + comissions) when there was no rule imposed on the subtask. There was no main effect of whether the task had a rule ($p=.86$) and no significant interaction between age and whether the task had a rule on the number of errors (p=.45). The only significant difference was an overall age effect, older adults made more errors than younger adults, $F(1,60)=13.20$, $p<.01$, $\eta_p^2=.19$.

Table 12

Number of Prospective Memory Errors Made by Rule Manipulation

	Younger Adults				Older Adults			
	Rule		*No Rule*		*Rule*		*No Rule*	
	M	SD	*M*	SD	*M*	SD	*M*	SD
Medication planning task	4.63	6.44	4.70	6.96	11.13	10.42	10.77	11.42
Group planning task	3.57	2.80	4.17	4.23	12.03	11.20	12.70	11.68

For the other subtask manipulations, it was not possible to analyze differences in absolute numbers because of the disparity in number of overall times that a subtask had to be remembered. Subtasks completed everyday had to be remembered a total of 56 times for the entire week whereas subtasks not completed everyday only had to be remembered 8 times. In the same way, subtasks completed multiple times had to be remembered 60 times for the entire week whereas subtasks completed one time only had to be remembered 4 times. Therefore, these absolute numbers were converted into proportions to provide a more accurate assessment of prospective memory performance. Sometimes that proportion is greater than 1 because participants not only forgot the prospective memory task, but then remembered to do it at the wrong time (omission and commission errors; see Table 13).

As expected, both age groups made a greater proportion of errors when the subtask did not need to be remembered everyday. Similarly, both age groups made a greater proportion of errors on subtasks that only had to be remembered one time instead of multiple times. These findings suggest that participants had more difficulty remembering tasks that had to be remembered infrequently and could not easily be incorporated as part of their routine. These patterns were observed across both prospective e memory tasks.

Table 13

Number and Proportion of Prospective Memory Errors by Task Manipulations

	Younger Adults			Older Adults		
	M	SD	/Total	*M*	SD	/Total
Medication planning						
Everyday[a]	7.67	11.09	.14	16.53	16.74	.31
Not everyday[b]	1.67	2.09	.21	5.37	5.56	.67
One time[c]	2.47	6.50	.62	6.50	6.84	1.63
Multiple times[d]	6.87	9.81	.11	15.40	15.60	.26
Group planning						
Everyday[a]	5.33	4.82	.10	19.00	17.24	.34
Not everyday[b]	2.40	3.73	.30	5.73	4.96	.72
One time[c]	2.20	2.85	.55	8.57	9.18	2.14
Multiple times[d]	5.53	4.50	.09	16.17	14.15	.27

[a]Total=56
[b]Total=8
[c]Total=4
[d]Total=60

Summary of Plan Implementation

Older adults made more prospective cost errors and total cost errors than younger adults. Also, all participants made more prospective cost errors and total cost errors during the group planning task as compared to the medication planning task. However, there was no influence of age group and task type on number of prospective cost errors and total cost errors. In addition, participants' performance on the medication planning task as assessed by total cost errors benefited from the experience of performing the group planning task beforehand.

The influence of the task complexity manipulations also was assessed in terms of error rates. There was no difference in prospective memory errors depending on whether the subtask contained a rule. However, both age groups made a greater proportion of errors for subtasks that were not part of their everyday routine.

Relationship between Plan Development and Plan Implementation

The third primary research question was whether there was a relationship between participants' plans and their subsequent performance (i.e., their ability to implement the plan). Three aspects of participants' *plan development* were considered for these analyses: type of retrieval cue, number of prospective instances, and planning style. The type of retrieval cue was investigated because of its relationship to the prospective component of the prospective memory task, the number of prospective instances was presumed to represent plan efficiency, and planning style was the measure of overall plan format.

Three measures of *plan implementation* were considered for these analyses: number of time counter presses, prospective cost (omission, commission, rule breaks, and time counter) and total cost (prospective cost + party attendance errors). Time counter presses were only compared to the type of retrieval cue selected whereas prospective cost and total cost were compared to the number of prospective instances and planning style. Prospective cost was selected as dependent variable of interest because the exit interview data showed that that participants reported focusing more attention on the prospective memory tasks than the party attendance task, and older adults reported devoting more attention to the prospective memory tasks than younger adults.[1]

Relationship between Retrieval Cue and Time Counter Presses

The relationship between type of retrieval cue and the number of time counter presses was assessed to determine whether some retrieval cues (i.e., time-based) were more dependent on monitoring activities and therefore required more self-initiated processing resources than other retrieval cues (i.e., event-based and mixed). For this analysis, event-based cues and mixed cues were combined into a single category labeled event because both cue types had event-based characteristics (see Table 14).

For the group planning task, there was no main effect of retrieval cue (p=.19), no main effect of age group (p=.51), and no significant interaction (p=.54). Likewise for the medication planning task, there was no main effect of retrieval cue (p=.35), no main

---

[1] For the group planning task versus the party attendance task, there was a main effect of task, $F(1,60)=11.11$, $p<.01$, $\eta_p^2=.16$, such that participants reportedly devoted more attention to the group planning task than the party attendance task. There was a marginally significant main effect of age, $F(1,60)=3.29$, $p=.07$, $\eta_p^2=.05$, such that older adults devoted more attention to both tasks than younger adults. However, there was no significant interaction effect (p=.97). For the medication planning task versus the party attendance task, there was a marginally significant main effect of task type such that participants reportedly devoted more attention to the medication planning task than the party attendance task, $F(1,60)=3.36$, $p=.06$, $\eta_p^2=.06$. There was also a main effect of age group such that older adults devoted more attention to both tasks than younger adults, $F(1,60)=5.72$, $p=.02$, $\eta_p^2=.09$. There was no significant interaction (p=.35).

effect of age group (p=.10), and no significant interaction (p=.33). Although not significant, the pattern in the data provide evidence that participants who selected event-based cues pressed the time counter button less frequently than participants who selected time-based cues with the exception of younger adults during the medication planning task.

Table 14

Relationship between Retrieval Cues and Time Counter Presses

	N	Younger Adults		N	Older Adults	
		M	SD		*M*	SD
Group planning task						
Event	2	6.50	.71	2	7.00	9.70
Time	28	14.96	11.11	28	29.86	30.53
Medication planning task						
Event	9	10.78	13.51	11	15.36	16.54
Time	21	10.57	7.25	19	27.84	37.78

Prospective Instances and Plan Implementation

A relationship between prospective instances and plan implementation was investigated to determine if fewer prospective instances was related to fewer errors. For each age group, the relationship between number of prospective instances and cost in terms of error rates was investigated using Pearson product-moment correlations. For the medication planning task, there was no correlation between the number of prospective instances and prospective cost for either younger adults (p=.58) or older adults (p=.62), and no correlation between the number of prospective instances and total cost for either younger adults (p=.28) or older adults (p=.38) (all correlations less than .21).

Likewise, for the group planning task, there was no correlation between the number of prospective instances and prospective cost for either younger adults (p=.46) or older adults (p=.72), and no correlation between the number of prospective instances and total cost for either younger adults (p=.36) or older adults (p=.55). The results from these correlations provide evidence that number of prospective instances was not related to error rates for either task or for either age group (all correlations less than .17).

The measure of number of prospective instances may not have been a good measure of plan efficiency because younger adults might not have interpreted the same task constraints as older adults particularly for the medication planning task. Younger adults had significantly fewer prospective instances in their medication plans because they often would take a medication within consecutive trials/hours (e.g., 8AM, 9AM, 10AM) which were counted as a single prospective instance. On the other hand, older adults would separate their medication administrations (e.g., 9AM, 12PM, 6PM) which would be counted as three prospective instances.

Planning Style and Plan Implementation

Group planning task. For prospective cost, there was no main effect of age group (p=.11), no main effect of planning style (p=.23), and no significant interaction between age group and planning style on prospective cost errors (p=.18). The pattern was similar for total cost (see Table 15).

Although the overall effect was not significant, there were *a priori* hypotheses that there may be age-related differences within a particular planning style. In addition, the number of observations was different in each cell and reduced the overall power to detect a difference (see Table 9). For these reasons, a decision was made to investigate performance separately for each planning style. A one-way ANOVA was conducted to determine if there were age-related differences in prospective cost within a planning style. There were age-related differences when participants used a chart layout/time-based planning style, $F(1,60)=11.19$, $p<.01$, $\eta_p^2=.25$, and a list layout/time-based planning style, $F(1,60)=7.63$, $p=.01$, $\eta_p^2=.30$, but no age-related differences when participants used a chart layout/event-based planning style ($p=.19$) (see Figure 3). However, there was only one older adult and two younger adults who used a chart layout/event-based planning style for this task and it is difficult to draw conclusions from this finding because of power concerns.

Table 15

Age Group, Planning Style, and Cost for Both Tasks

	Younger Adults			Older Adults		
	N	M	SD	N	M	SD
Prospective Cost						
Medication planning task						
Chart/Time-based	17	18.65	10.44	6	22.67	14.77
List/Time-based	4	21.50	11.79	11	68.55	41.57
Chart/Event-based	7	21.85	19.77	6	24.00	12.12
List/Event-based	2	30.00	31.11	5	52.00	42.22
Group planning task						
Chart/Time-based	21	25.00	14.37	15	48.40	27.29
List/Time-based	7	28.29	18.38	13	71.92	39.16
Chart/Event-based	2	31.00	2.83	1	20	N/A
List/Event-based	0	0	0	1	40.00	N/A
Total Cost						
Medication planning task						
Chart/Time-based	17	30.53	18.05	6	68.83	26.47
List/Time-based	4	48.00	26.07	11	119.45	38.34
Chart/Event-based	7	30.14	23.29	6	65.17	23.89
List/Event-based	2	51.00	49.50	5	101.80	69.31
Group planning task						
Chart/Time-based	21	39.00	21.18	14	96.60	31.55
List/Time-based	7	47.86	33.80	14	124.70	47.93
Chart/Event-based	2	47.00	1.41	1	33.00	N/A
List/Event-based	0	0	0	1	119.00	N/A

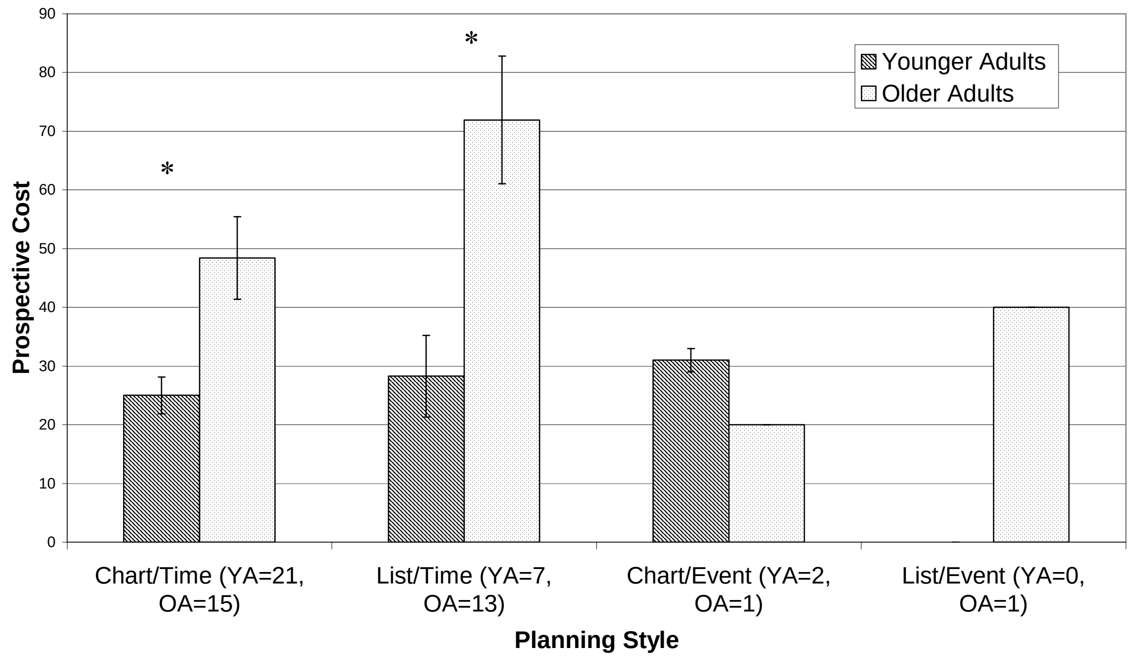


Figure 3. Prospective cost for group planning task by age group (means and standard error bars).

Medication planning task. For prospective cost, older adults made more prospective cost errors than younger adults on the medication planning task as evidenced by a main effect of age, $F(1,60)=5.66$, $p=.02$, $\eta_p^2=.10$. There was also a significant main effect of planning style, $F(1,60)=2.91$, $p=.04$, $\eta_p^2=.15$, but no interaction effect ($p=.10$). The pattern was similar for total cost.

Follow-up analyses conducted for the group planning task revealed no age-related differences in prospective cost when participants used a chart layout/event-based planning style ($p=.82$), a chart layout/time-based planning style ($p=.47$), or a list layout/event-based planning style ($p=.54$) for the medication planning task (see Figure 4). The only significant age-related difference was when participants used a list layout/time-based planning style such that older adults made significantly more errors than younger adults, $F(1,60)=4.77$, $p=.05$, $\eta_p^2=.27$.

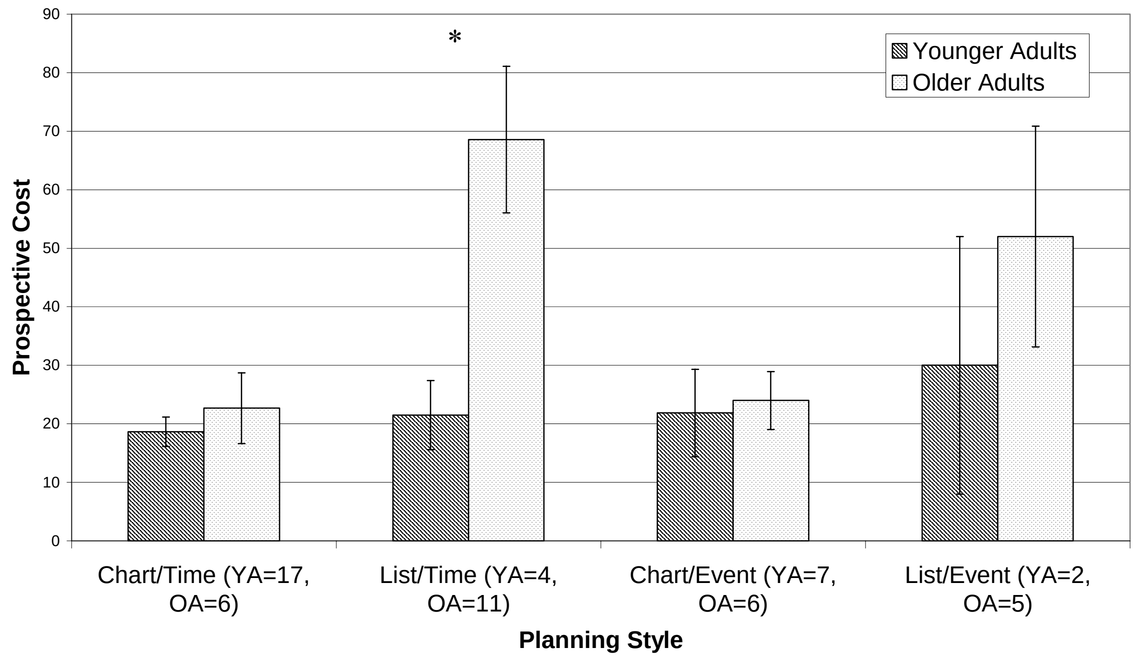


Figure 4. Prospective cost for the medication planning task by age group (means and standard error bars).

The relationship between planning experience and planning style. Based on the findings thus far, it appears that age-related differences in prospective cost are related to the planning style selected. A related question at this point is whether there are individual difference characteristics that predict which participants select which planning styles. An analysis was conducted to assess whether there was a relationship between planning style and planning experience given the importance of task familiarity/experience as a potential environmental support. For this analysis, participants were divided into categories for low and high planning experience based on a median split for the planning experience score for their age group (see Table 16). Across age groups, there was a relationship between planning experience and planning style for the medication planning task, $\chi^2(1, N = 58) = 10.94$, $p=.01$. The pattern in the data is such that participants with low planning experience selected more plans with a list layout/time-based cue plan whereas participants with high planning experience selected more plans with a chart layout/event-based cue.

Table 16

Planning Experience and Planning Style for the Prospective Tasks

	Low Planning Experience			High Planning Experience		
	Younger[a]	*Older*[b]	*Total*	*Younger*[c]	*Older*[d]	*Total*
Medication planning						
Chart/time	9	4	**13**	8	2	**10**
List/time	4	7	**11**	0	4	**4**
Chart /event	2	1	**3**	5	5	**10**
List/event	0	1	**1**	2	4	**6**
Group planning						
Chart/time	10	6	**16**	11	9	**20**
List/time	5	8	**13**	2	5	**7**
Chart/event	0	0	**0**	2	1	**3**
List/event	0	0	**0**	0	1	**1**

[a] The mean score for low experience younger adults was 61.40 (*SD*=9.52).
[b] The mean score for low experience older adults was 69.21 (*SD*=9.99).
[c] The mean score for high experience younger adults was 91.53 (*SD*=13.37)
[d] The mean score for high experience older adults was 108.44 (*SD*=17.52).

However, there was no relationship between planning experience and planning style for the group planning task, (p=.10). In addition, the pattern was not in the same direction for the group planning task; rather participants with high experience were more likely to choose a chart layout/time-based planning style whereas participants with low experience were more likely to choose a list layout/time-based planning style.

An additional analysis was conducted to determine if specific medication planning experience was related to the planning style selected for the medication planning task given the finding that general planning experience was related to planning style. To assess medication planning experience, the scores from three questions were combined: two questions concerned whether participants used strategies to remember to take their medications and the third question was the number of medications that the participant took. For this analysis, participants were divided into categories for low and high medication experience based on a median split for the medication experience score for their age group (see Table 17). A chi-square test revealed a significant relationship between planning style and medication planning experience, $\chi^2(1, N = 58) = 10.61$, p=.01. The pattern in the data is such that participants with higher levels of medication planning experience were more likely to choose event-based cues than participants with lower levels of medication planning experience.

Table 17

Medication Experience and Planning Style

	Low Medication Experience			High Medication Experience		
	Younger[a]	*Older*[b]	*Total*	*Younger*[c]	*Older*[d]	*Total*
Medication planning						
Chart/time	11	4	**15**	6	2	**8**
List/time	1	6	**7**	3	5	**8**
Chart/event	2	2	**4**	5	4	**9**
List/event	0	0	**0**	2	3	**7**

[a] The mean score for low medication experience for younger adults was 2.00 (*SD*=1.04).
[b] The mean score for low medication experience for older adults was 7.86 (*SD*=3.68) .
[c] The mean score for high medication experience for younger adults was 9.44 (*SD*=2.53).
[d] The mean score for high medication experience for older adults was 14.75 (*SD*=2.46).

Lastly, is it the case the measures of planning experience are important predictors of the planning style selected or is this relationship mediated by working memory capacity? Using scores from the Automated Operation Span, participants were divided into lower and higher working memory capacity based on a median split for each age group (see Table 18). Working memory capacity was not related to the planning style selected for either the medication planning task (*p*=.23) or the group planning task (*p*=.59).

Table 18

Working Memory and Planning Style for Both Tasks

	Low Working Memory			High Working Memory		
	Younger[a]	*Older*[b]	*Total*	*Younger*[c]	*Older*[d]	*Total*
Medication planning						
Chart/time	9	2	**11**	8	4	**12**
List/time	2	7	**9**	2	4	**6**
Chart/event	3	0	**3**	4	6	**10**
List/event	0	4	**4**	2	4	**3**
Group planning						
Chart/time	11	5	**16**	10	10	**20**
List/time	2	9	**11**	5	4	**9**
Chart/event	1	0	**1**	1	1	**2**
List/event	0	1	**1**	0	0	**0**

[a] The mean score for low working memory younger adults was 58.14 (*SD*=8.28).
[b] The mean score for low working memory older adults was 70.06 (*SD*=3.26).
[c] The mean score for high working memory younger adults was 18.73 (*SD*=11.51)
[d] The mean score for high working memory older adults was 47.13 (*SD*=8.38).

Summary for relationship between plan development and plan implementation. The measure of prospective instances was not correlated with number of errors for either age group for both prospective memory tasks providing evidence that this measure of plan development was not predictive of performance and may not have been an accurate measure of plan efficiency. However, planning style was related to prospective cost for the medication planning task such that the only age-related difference in prospective cost was found for participants who used a list layout/time-based planning style. There was no relationship between the planning style selected and medication planning experience or working memory capacity. However, there was a relationship between the measure for general planning experience and planning style selected for the medication planning task. Participants with higher levels of planning experience were more likely to choose a chart layout/time-based planning style whereas participants with lower levels of planning experience were more likely to choose a list layout/time-based planning style.

CHAPTER 4

GENERAL DISCUSSION

The purpose of the present study was to investigate the role of planning in the performance of complex prospective memory tasks. Although planning has been investigated in the performance of complex prospective memory tasks (Craik & Bialystok, in press; Kliegel et al., 2000; Kliegel et al., 2003), the findings from these studies provided an incomplete picture of age-related differences because there was no assessment of the relationship between plan development and plan implementation (Craik & Bialystok) or older adults did not develop their own retrieval cues while performing a familiar task (Kliegel et al., 2000, 2003).

The goal of the present study was to investigate age-related differences in plan development, plan implementation, and the relationship between the two for a familiar (medication) and an unfamiliar task (group). It was hypothesized that older adults would benefit from the opportunity to develop their own retrieval cues for a familiar task within a well-known context (i.e., their routine) because they could use their experience to develop an effective plan. An effective plan would compensate for age-related declines in processing resources by providing environmental support.

There were three primary research questions that this study sought to answer. The fourth research question about interactions of age, planning components, and tasks is addressed within the results of the three research questions. First, how did participants develop plans to remember to perform the tasks? Although older adults spent more time planning than younger adults, all participants developed their plans within the time limit and older adults were as accurate as younger adults in their plan development.

Furthermore, there were no age-related differences in planning styles for either prospective memory task. However, participants spent more time developing their plans for the group planning task than the medication planning task and younger adults had fewer prospective instances in their plans.

Second, could participants implement their plans? Participants made more prospective cost errors and total cost errors for the group planning task as compared to the medication planning task. In addition, older adults made more prospective cost errors and total cost errors than younger adults. However, both age groups made a greater proportion of errors for subtasks that were not part of their everyday routine.

Third, was there a relationship between plan development and plan implementation? Planning style did not have an influence on the number of prospective cost errors or total cost errors for either age group for the group planning task. However, planning style did have an influence on age-related differences in prospective errors for the medication planning task. More specifically, age-related differences in prospective cost errors emerged for participants who used a list layout/time-based planning style. Participants who used a list layout/time-based planning style scored lower on the planning experience questionnaire. Therefore, planning (as assessed by planning style and planning experience) had an influence on age-related differences in prospective memory performance such that older adults with lower levels of planning experience were more likely to choose a suboptimal planning style for the medication planning task. Conversely, those older adults who did not choose this planning style did not differ significantly from younger adults in prospective cost errors for the medication planning task.

The results of this research have clear theoretical relevance. Current frameworks of prospective memory have virtually ignored the planning aspect of prospective memory tasks. Furthermore, there is little research into how participants would develop and implement plans for a familiar prospective memory task. Task familiarity (i.e., context) influenced the plans developed by older adults such that half of the older adults developed different planning styles for each task whereas younger adults did not demonstrate the same effect. In addition, when participants were given the opportunity to plan when they would remember the task (i.e., develop their own retrieval cues) and how they would remember the task (i.e., develop an external aid), there were no age-related differences in prospective cost for three out of four of the planning styles for a familiar task (i.e., medication planning). These findings provides evidence that older adults can perform as well as younger adults when given the opportunity to develop plans for familiar, complex prospective memory tasks provided they develop good plans. A good plan would be one that reduces demands on self-initiated processing resources at encoding and retrieval thereby providing increased environmental support (Craik, 1986); in the present study a good plan was a chart layout with event-based cues.

Participants provided themselves with varying levels of environmental support when they selected a planning style to help support the retrospective component (*what*) and a retrieval cue to help support the prospective component (*when*). However, it was surprising that there were age-related differences in plan layout, but no age-related differences in the retrieval cue selected. Plan layout was not hypothesized to influence prospective memory performance; rather plan layout emerged as a variable of interest after the data had been collected. The reason plan layout had not been considered was because it was assumed that allowing participants to develop and reference their plans would control for any age-related differences in the retrospective component of prospective memory. However, findings from this study provide evidence that it is not sufficient to have an external aid as a reminder of *what* needs to be done. It is important to consider how this information is organized. A chart that organizes information by day and hour requires fewer processing resources for this task than a list that organizes information by subtask (e.g., Medication 1) because the prospective memory tasks were structured by day and time.

The structure of the prospective memory tasks also may explain why participants (older adults in particular) chose more time-based cues for both tasks. Although it is plausible that participants thought time-based cues would be more helpful for this task because the events would not be "real", they may have been biased into choosing time-based cues because of the way the task was presented to them. Participants were asked to provide their weekly routine hour-by-hour and then they were told before they developed their plans that they would participate in a pretend week presented hour-by-hour based on their weekly routine. Unfortunately, there is no way to know which explanation fits the current study. However, future research studies using this paradigm should consider incorporating ways to reduce demands on time-based cues. Perhaps, the weekly routine interview could be more general in nature (e.g., what activities do you do on a typical Monday morning?).

The ability to develop and use a plan, however, was not sufficient to eliminate age-related differences in prospective memory performance. Older adults did not show the same benefit when developing plans for the group planning task even though this task was analogous to the medication planning task. There are several plausible explanations for this finding. First, older adults may have more experience using their routine to support their medication planning whereas their routines did not support their performance as much for the group planning task. Second, although not significant, older adults did rate medication planning as most important and may have focused more of their resources towards remembering this task as compared to the group planning task. Third, older adults reported significantly more experience with taking medications than scheduling groups and they may have been able to draw upon their crystallized knowledge of this task in developing and implementing their plans. Regardless of the specific reason, the finding that older adults' performance benefited from the medication planning task provides evidence for the importance of incorporating familiar tasks into the study of age-related differences in prospective memory.

However, not all older adults demonstrated performance benefits during the medication planning task. Over one-third of the older adults adopted a poor planning style (i.e., list layout/time-based) during the medication planning task. Participants who developed the list layout/time-based planning style had lower scores on the planning experience questionnaire. A lower score on the planning experience questionnaire means that these participants were less likely to use planning strategies to help them remember to perform tasks in their everyday lives. Moreover, although planning experience and medication experience were related to planning style, working memory capacity was not related to planning style. This finding provides evidence that planning experience is a worthy construct of interest.

This research also has practical implications. These findings provide guidance for the development of training programs or environmental support to improve prospective memory for older adults. For example, the use of event-based cues and a chart-based layout could be used to develop technologies to improve older adults' prospective memory performance. For example, a search on the Internet for medication chart shows that organizations recommend that older adults keep a medication chart to help them remember to take their medications (American Heart Association, http://www.americanheart.org/presenter.jhtml?identifier=92). However, there is little discussion about additional strategies that may benefit an older adult such as the use of event-based cues to help remind them to take their medications.

The present study was an initial investigation to bring elements of participants' everyday lives into a controlled setting within the laboratory, but there are still many unanswered questions. One advantage of the current study was the control exerted over the types of retrieval cues that participants could use which enabled direct comparisons between the use of retrieval cues (i.e., planning) and subsequent prospective memory performance. However, this advantage also created a limitation to this study. By controlling the retrieval cues available to participants (e.g., external aids, routine), they may not have had access to other cues that would support their performance such as a calendar, leaving items under their keys, placing a traditional medication organizer on the bathroom counter, etc. Future research efforts should consider how to incorporate additional retrieval cues within a similar experimental paradigm. An additional issue was that participants were not accurately constrained by the problems. For example, younger adults might take the same medication at 1PM, 2PM, and 3PM whereas older adults would distribute their administration times probably based on their experience taking medications (e.g., 9AM, 12PM, 6PM). Future research projects in this area should introduce additional rules that correspond to the actual demands of the task.

To summarize, the goal of the present study was to understand the role of planning in the performance of complex prospective memory tasks and whether there were differences related to the age of the participant or the type of task. However, the overall goal of this study was to try to provide some insight into the discrepant findings in this area of research. Craik's (1986) original model of environmental support proposed that there would be age-related declines in the performance of prospective memory tasks in the absence of cues in the environment (i.e., environmental support). However, research in this area has generated mixed findings regarding age-related differences in performance (Light, 1991). The location of the prospective memory study (i.e., inside the laboratory or outside the laboratory) has frequently been cited as a reason for these discrepant findings such that older adults have environmental supports available to them outside of the laboratory that are not available during traditional measures of prospective memory.

The findings from this study provide evidence that it is not the location of the study per se, but rather the level of environmental support available that influences the presence (or absence) of age-related differences in performance. Age-related declines in the performance of prospective memory tasks can be ameliorated when participants remember a familiar task (i.e., medication planning) within a well-known context (i.e., their routine) and have the opportunity to develop their own retrieval cues (i.e., support the prospective component) and an external aid (i.e., support the retrospective component). Therefore, it is critical to understand the role of environmental support in the performance of prospective memory tasks to fully understand where (and under what circumstances) age-related declines in prospective memory emerge.

APPENDIX A

Reasons Why Participants were Excluded

Participant ID#	Age Group	Reason for Exclusion
127	Younger	Participant was an outlier for the number of prospective memory errors made.*
205	Older	Older adult chose to only complete the medication planning task and did not want to participant in the week for the group planning task.
207	Older	Older adult could not complete the Automated Operation Span during the first session.
220	Older	Older adult could not complete the Automated Operation Span during the first session.
225	Older	Older adult could not complete the Automated Operation Span during the first session.
228	Older	Participant was an outlier for the number of prospective memory errors made.*
232	Older	Participant was an outlier for the number of prospective memory errors made.*

*Participants were classified as outliers if they made errors greater (or fewer) than two standard deviations when compared to the mean for their respective age groups.

APPENDIX B

Planning Experience Questionnaire

Instructions: The following section is divided into five parts by type of activity: (1) Work/School/Volunteering, (2) Finances, (3) Health, (4) Family/Social, and (5) Entertainment. Read and respond to each question by circling the number that matches how frequently you perform the following activities on the scale from Never (1) to Always (6).
For each question that you choose a number between 2-6, please take a moment to answer the second part of the question.

Work/School/Volunteering:

1) I plan ahead to make sure that I attend my appointments.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead to attend your appointments?

____

____

____

2) I plan out the errands I need to run.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan out your errands?

____

____

____

3) I have ways to make sure I get all the items I wanted to get when I am at the grocery store.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you make sure you get all the desired items?

____

____

____

4) I have strategies to make sure that I can get back to somewhere I have been to before (for example, remembering directions).

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you accomplish that?

____

____

____

5) I have ways to make sure I perform non-routine household chores (for example, cleaning out storage).

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you accomplish that?

____

____

____

Finances:

1) I come up with strategies to help me make sure I pay my monthly bills on time.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what strategies are those?

____

____

____

2) I have strategies to remember to pay unexpected bills on time.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what strategies are those?

____

____

____

3) I plan out how much I am going to spend before I buy something.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan out your spending?

____

____

____

4) I plan ahead when it comes to paying taxes.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead to pay your taxes?

____

____

____

5) I have strategies to help me stay within my budget.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what strategies are those?

____

____

____

Health:

1) I have ways to ensure I take my medications.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the ways you ensure you take your medicine?

____

____

____

2) I plan out my meals to make sure they are healthy.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan out your healthy meals?

____

____

____

3) I have strategies to help me make sure I exercise.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the strategies?

____

____

____

4) I plan ahead to make sure I am able to attend my doctor appointments.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead?

____

____

____

5) I plan ahead to make sure I refill my prescriptions before I run out.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead?

____

____

____

Family/Social:

1) I have strategies that help me make sure I get holiday gifts for the people I know.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the strategies?

____

____

____

2) Other people make plans for me.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the types of plans they make for you?

3) I have strategies that help me make sure I call people when I want to.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the strategies?

4) I am responsible for making plans for other people to take care of things.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan for others?

5) I have strategies that help me make sure I include others in my routine (for example: having lunch with a friend, birthdays).

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the strategies?

Entertainment:

1) I avoid missing my favorite television program by creating a plan.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what kind of plan?

____

____

____

2) I plan ahead to make sure I have time to participate in my hobbies.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead for your hobbies?

____

____

____

3) I plan ahead to make sure I have the resources (for example: time, money) available to take a vacation.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead?

____

____

____

4) I have strategies to make sure that I will have time to relax, but still get all my work/responsibilities done.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, what are the strategies?

____

____

____

5) I attend special outings (for example: parties, movies) by planning around my normal routine.

0	1	2	3	4	5	6
Not Applicable	Never					Always

If 2 through 6, how do you plan ahead?

____

____

____

APPENDIX C

WEEKLY ROUTINE FOR OLDER ADULT

Day	Time	Activity	Detail
Monday	7:00 AM	Coffee and personal chores	
Monday	8:00 AM	Van signup	Going to malls and market
Monday	9:00 AM	Exercise	
Monday	10:00 AM	In Apartment	Doing chores, having coffee, and doing crossword puzzles
Monday	11:00 AM	Pack for midweek house sitting	
Monday	12:00 PM	Lunch	Cottage cheese
Monday	1:00 PM	Library to get a book to read at house sitting, making group coffee, and cleaning the coffee pot	
Monday	2:00 PM	Leave on 2:15 to go to her daughter's house	
Monday	3:00 PM	Arrived at daughter's house	
Monday	4:00 PM	Tidying up her house from the weekend	Cleaning the cat box
Monday	5:00 PM	Reading and brushing the cat	
Monday	6:00 PM	Looking around kitchen to see what's for supper	Brown rice and frozen vegetables and beans
Monday	7:00 PM	Reading and doing crossword puzzles	
Monday	8:00 PM	Reading and doing crossword puzzles	
Monday	9:00 PM	In bed reading	Magazine - Harper's
Monday	10:00 PM	Sleep	
Monday	11:00 PM	Sleep	
Monday	12:00 AM	Sleep	
Tuesday	7:00 AM	Coffee and reading the newspaper	AJC
Tuesday	8:00 AM	Chores around the house	
Tuesday	9:00 AM	Laundry	
Tuesday	10:00 AM	Yard work and water plants	
Tuesday	11:00 AM	Crossword puzzles and reading	
Tuesday	12:00 PM	Lunch - exploring the refrigerator	Cottage cheese and sandwich
Tuesday	1:00 PM	Reading	
Tuesday	2:00 PM	Nap	
Tuesday	3:00 PM	Get the mail and have tea	
Tuesday	4:00 PM	Clean the cat's box	
Tuesday	5:00 PM	Go for a walk	Around the block to the corner
Tuesday	6:00 PM	Dinner - Exploring the	Brown rice and frozen vegetables

		refrigerator	and beans
Tuesday	7:00 PM	Reading	
Tuesday	8:00 PM	Reading	
Tuesday	9:00 PM	Reading in bed	Magazine - Harper's
Tuesday	10:00 PM	Sleep	
Tuesday	11:00 PM	Sleep	
Tuesday	12:00 AM	Sleep	
Wednesday	7:00 AM	Coffee and reading the newspaper	
Wednesday	8:00 AM	Chores around the house	
Wednesday	9:00 AM	Bus to Kroger	
Wednesday	10:00 AM	Shopping at Kroger	
Wednesday	11:00 AM	Back to daughter's home	Exercise from bus stop
Wednesday	12:00 PM	Eating lunch	Bread and sandwich meat
Wednesday	1:00 PM	Reading	
Wednesday	2:00 PM	Nap	
Wednesday	3:00 PM	Getting daughter's mail and yard work	Pulling weeds
Wednesday	4:00 PM	Reading	
Wednesday	5:00 PM	Walking	Walking around the neighborhood
Wednesday	6:00 PM	Supper	Prepared curry meals
Wednesday	7:00 PM	Packing and arranging clothes	
Wednesday	8:00 PM	Reading, crossword puzzles, and petting cat	
Wednesday	9:00 PM	Reading in bed	Magazine - Harper's
Wednesday	10:00 PM	Sleep	
Wednesday	11:00 PM	Sleep	
Wednesday	12:00 AM	Sleep	
Thursday	7:00 AM	Coffee and reading the newspaper	
Thursday	8:00 AM	Getting house ready for them to come back	Making sure cat has enough to eat
Thursday	9:00 AM	Water around the yard	
Thursday	10:00 AM	Cleaning	Sweep the basement, sit down, clean the lint trap, etc.
Thursday	11:00 AM	Cleaning	Little chores mixed with reading and crossword puzzles
Thursday	12:00 PM	Lunch	Salad
Thursday	1:00 PM	Sorting newspapers and taking out the trash	Separate out each section
Thursday	2:00 PM	One last check of the house to make sure everything is ok and leave at 2:15	
Thursday	3:00 PM	Arrived at 5 points station and on way back to Lutheran Towers	
Thursday	4:00 PM	Pick up mail and visit with people and see what's happened since been gone	
Thursday	5:00 PM	Unpacking	
Thursday	6:00 PM	Go to the library to restock book supply	
Thursday	7:00 PM	Dinner - Exploring the	Prepared meals

		refrigerator	
Thursday	8:00 PM	Visiting or an event at Lutheran Towers	
Thursday	9:00 PM	Reading in bed	
Thursday	10:00 PM	Sleep	
Thursday	11:00 PM	Sleep	
Thursday	12:00 AM	Sleep	
Friday	7:00 AM	Eat breakfast	Applesauce and fruit
Friday	8:00 AM	Putter around the apartment	Checking closet to see if need to get out winter clothes
Friday	9:00 AM	Be on the van to Kroger	
Friday	10:00 AM	Shopping at Kroger	
Friday	11:00 AM	Getting mail	
Friday	12:00 PM	Lunch	Salad
Friday	1:00 PM	Event at Lutheran Towers	Visiting with people
Friday	2:00 PM	Nap	
Friday	3:00 PM	Medical education	Nurse will come and take blood pressure and check hearing and cholesterol
Friday	4:00 PM	Happy hour with friends	
Friday	5:00 PM	Visiting with friends	
Friday	6:00 PM	Setting up for bingo	
Friday	7:00 PM	Dinner	Brown rice and frozen vegetables and beans
Friday	8:00 PM	Read	
Friday	9:00 PM	Reading in bed	
Friday	10:00 PM	Sleep	
Friday	11:00 PM	Sleep	
Friday	12:00 AM	Sleep	
Saturday	7:00 AM	Coffee	
Saturday	8:00 AM	Walk to Publix	
Saturday	9:00 AM	Publix and Walgreens and then walk	
Saturday	10:00 AM	Reading	
Saturday	11:00 AM	Visiting with people	
Saturday	12:00 PM	Lunch	Cottage cheese and applesauce
Saturday	1:00 PM	Get the mail	Stay down in main room to visit
Saturday	2:00 PM	Saturday movie	Lucy
Saturday	3:00 PM	Saturday movie	Lucy
Saturday	4:00 PM	Come back to apartment	
Saturday	5:00 PM	Doing rounds to check on people	
Saturday	6:00 PM	Reading and writing letters	
Saturday	7:00 PM	Dinner	Chicken and vegetables
Saturday	8:00 PM	Reading	
Saturday	9:00 PM	Reading in bed	
Saturday	10:00 PM	Sleep	
Saturday	11:00 PM	Sleep	

Saturday	12:00 AM	Sleep	
Sunday	7:00 AM	Coffee	
Sunday	8:00 AM	Walk to Piedmont Park	
Sunday	9:00 AM	Walk to Piedmont Park	
Sunday	10:00 AM	Walk to Piedmont Park	
Sunday	11:00 AM	Come back to apartment	Go down to the library to read the Sunday paper
Sunday	12:00 PM	Lunch	Prepared salad with bacon, eggs, and cheese (Prepared salad)
Sunday	1:00 PM	Reading	
Sunday	2:00 PM	Nap	
Sunday	3:00 PM	Visiting	
Sunday	4:00 PM	Reading	
Sunday	5:00 PM	Starting to pack to go to daughter's house	
Sunday	6:00 PM	Supper	Brown rice and frozen vegetables and beans
Sunday	7:00 PM	Reading	
Sunday	8:00 PM	Getting apartment clean and chores	
Sunday	9:00 PM	Reading in bed	
Sunday	10:00 PM	Sleep	
Sunday	11:00 PM	Sleep	
Sunday	12:00 AM	Sleep	

WEEKLY ROUTINE FOR YOUNGER ADULT

Day	Time	Action	Detail
Monday	7:00 AM	Sleep	
Monday	8:00 AM	Get up and get ready for class	
Monday	9:00 AM	Start going to class	
Monday	10:00 AM	Class	Cell Biology
Monday	11:00 AM	Class	Developmental Biology
Monday	12:00 PM	Class	Cell Lab
Monday	1:00 PM	Class	Cell Lab
Monday	2:00 PM	Class	Cell Lab
Monday	3:00 PM	Class	Spanish
Monday	4:00 PM	Go back to room and eat a snack	Cereal
Monday	5:00 PM	Work on the computer	
Monday	6:00 PM	Homework	
Monday	7:00 PM	Homework	
Monday	8:00 PM	Eat dinner	Rice and stew
Monday	9:00 PM	Hang out with boyfriend	
Monday	10:00 PM	Hang out with boyfriend	
Monday	11:00 PM	Hang out with boyfriend	
Monday	12:00 AM	Sleep	
Tuesday	7:00 AM	Wake up and get ready and head to class	
Tuesday	8:00 AM	Class	Microbiology
Tuesday	9:00 AM	Class	Microbiology
Tuesday	10:00 AM	Class	Psychology Lab
Tuesday	11:00 AM	Class	Psychology Lab
Tuesday	12:00 PM	Lunch	Fries
Tuesday	1:00 PM	Head back to room	
Tuesday	2:00 PM	Homework	
Tuesday	3:00 PM	Homework	
Tuesday	4:00 PM	Homework	
Tuesday	5:00 PM	Gym	
Tuesday	6:00 PM	Eat dinner	Rice and stew
Tuesday	7:00 PM	Homework	
Tuesday	8:00 PM	Homework	
Tuesday	9:00 PM	Homework	
Tuesday	10:00 PM	Hang out with boyfriend	
Tuesday	11:00 PM	Hang out with boyfriend	
Tuesday	12:00 AM	Sleep	
Wednesday	7:00 AM	Sleep	
Wednesday	8:00 AM	Get up and get ready for class	

Wednesday	9:00 AM	Start going to class	
Wednesday	10:00 AM	Class	Cell Biology
Wednesday	11:00 AM	Class	Developmental Biology
Wednesday	12:00 PM	Class	Biology Research Lab
Wednesday	1:00 PM	Class	Biology Research Lab
Wednesday	2:00 PM	Class	Biology Research Lab
Wednesday	3:00 PM	Class	Spanish
Wednesday	4:00 PM	Go back to room and eat a snack	Cereal
Wednesday	5:00 PM	Work on the computer	
Wednesday	6:00 PM	Homework	
Wednesday	7:00 PM	Homework	
Wednesday	8:00 PM	Eat out dinner	Tacqueria del Sol
Wednesday	9:00 PM	Homework	
Wednesday	10:00 PM	Homework	
Wednesday	11:00 PM	Homework	
Wednesday	12:00 AM	Sleep	
Thursday	7:00 AM	Wake up and get ready and head to class	
Thursday	8:00 AM	Class	Microbiology
Thursday	9:00 AM	Class	Microbiology
Thursday	10:00 AM	Class	Biology Research Lab
Thursday	11:00 AM	Class	Biology Research Lab
Thursday	12:00 PM	Class	Biology Research Lab
Thursday	1:00 PM	Class	Biology Research Lab
Thursday	2:00 PM	Class	Biology Research Lab
Thursday	3:00 PM	Go back to room and eat a snack	
Thursday	4:00 PM	Gym	
Thursday	5:00 PM	Go back to room and shower	
Thursday	6:00 PM	Work on the computer	
Thursday	7:00 PM	Homework	
Thursday	8:00 PM	Homework	
Thursday	9:00 PM	Eat dinner	Home style Persian Food
Thursday	10:00 PM	Homework	
Thursday	11:00 PM	Homework	
Thursday	12:00 AM	Sleep	
Friday	7:00 AM	Sleep	
Friday	8:00 AM	Get up and get ready for class	
Friday	9:00 AM	Start going to class	
Friday	10:00 AM	Class	Cell Biology
Friday	11:00 AM	Class	Developmental Biology
Friday	12:00 PM	Class	Biology Research Lab
Friday	1:00 PM	Class	Biology Research Lab
Friday	2:00 PM	Class	Biology Research Lab

Friday	3:00 PM	Class	Spanish
Friday	4:00 PM	Go back to room and eat a snack	Cereal
Friday	5:00 PM	Go home	
Friday	6:00 PM	Home	Marietta
Friday	7:00 PM	Go out with friends	
Friday	8:00 PM	Go to the movies	Comedy
Friday	9:00 PM	Go to the movies	Comedy
Friday	10:00 PM	Eat dinner	Apres Diem
Friday	11:00 PM	Eat dinner	Apres Diem
Friday	12:00 AM	Eat dinner	Apres Diem
Saturday	7:00 AM	Sleep	
Saturday	8:00 AM	Sleep	
Saturday	9:00 AM	Sleep	
Saturday	10:00 AM	Meet boyfriend at mall	Perimeter Mall
Saturday	11:00 AM	Mall	Perimeter Mall
Saturday	12:00 PM	Mall	Perimeter Mall
Saturday	1:00 PM	Lunch	Chinese and Vegetarian
Saturday	2:00 PM	Go the park	Piedmont Park
Saturday	3:00 PM	Go back home	
Saturday	4:00 PM	Clean the house	Clean the kitchen
Saturday	5:00 PM	Clean the house	Vacuuming
Saturday	6:00 PM	Go out with girlfriends	Café
Saturday	7:00 PM	Go out with girlfriends	Café
Saturday	8:00 PM	Go out with girlfriends	Café Istabul
Saturday	9:00 PM	Go out with girlfriends	Café Istabul
Saturday	10:00 PM	Go out with girlfriends	Café Istabul
Saturday	11:00 PM	Go back home	
Saturday	12:00 AM	Sleep	
Sunday	7:00 AM	Sleep	
Sunday	8:00 AM	Sleep	
Sunday	9:00 AM	Eat breakfast with parents	Eggs and traditional Persian breakfast
Sunday	10:00 AM	Chores at the house	Yardwork and clean the garage
Sunday	11:00 AM	Shopping with mom	Northpointe
Sunday	12:00 PM	Lunch with mom	Northpointe
Sunday	1:00 PM	Go back home	
Sunday	2:00 PM	Start getting ready by taking shower and getting dressed	
Sunday	3:00 PM	Start getting ready by taking shower and getting dressed	
Sunday	4:00 PM	Go to a relative's house	
Sunday	5:00 PM	Go to a relative's house	

Sunday	6:00 PM	Go to a relative's house	
Sunday	7:00 PM	Have dinner at relative's house	
Sunday	8:00 PM	Head for campus	
Sunday	9:00 PM	Homework	
Sunday	10:00 PM	Homework	
Sunday	11:00 PM	Homework	
Sunday	12:00 AM	Sleep	

APPENDIX D

Rules for Coding Participants' Plans

Participants' plans were coded on three dimensions: retrieval cue, layout, and planning style. The following are the rules for each dimension.

Retrieval cue

Participants' plans were coded on type of retrieval cue which consisted of event-based, time-based, and a mix between the two.

- Event-based: If a participant's plan consisted of different events such as breakfast, after the gym, dinner, bedtime, etc. It gets a little tricky when someone places these events within a chart and there are corresponding times for those events. In this case, you would need to go back to the planning interview (there's a table in each participants' packet) and see what they said when they were interviewed. If they mention events then this plan would be categorized as event-based. The only exception is participant 105 for the medication planning task – this participant mentioned one event for one time that they would take medication 6 (out of the 21 administrations) - they listed bedtime.
- Time-based: If a participant's plan consisted of different times such as 11AM, 2PM, etc. However, if the participant's plan has times that are **spread apart** and that correspond to typical events – wake up (7AM), lunch (12PM), dinner (6PM), and bedtime (10PM) then these plans would be coded as mixed. It is important to keep in mind that these times would need to be spread apart – it would not be counted as mixed if a participant performed all prospective memory activities within three consecutive hours (e.g., 7AM, 8AM, 9AM). Also, these times do not

necessarily need to correspond to standard times if they are same each (e.g., 12PM, 3PM, 6PM).

- Mixed: Plans were coded as mixed if they consisted of both event-based and time-based cues. Participants' plans would be coded as mixed even if they are mainly time-based, but one subtask is listed as an event. Finally, participants' plans would be coded as mixed under the circumstances listed in the time-based explanation.

Layout

Participant's plans were coded on three types of layouts: chart, list, or a mix between the two.

- Chart: Participants' plans were coded as charts if they created a chart to help them remember. A participant's plan was coded as a chart even if they also had a list in their participant packet because of the observation that most participants started with a list, converted this list to a chart, and only relied on the chart during the experimental session. The exception to this rule was participant 226 who was coded as mixed for the group planning task because he or she actually made checkmarks on their list during the experimental session.
- List: Participants' plans were coded as a list if they only relied on a list to remember and did not create a chart.
- Mix: Participants' plans were only coded as mixed if participants included both a chart and a list on the same sheet of paper. If they had a chart and a list on separate sheets of paper then this was coded as a chart because of the observation

that most participants started with a list, converted this list to a chart, and only relied on the chart during the experimental session.

<u>Planning Style</u>

Participants' plans were coded within four planning styles: chart layout/event-based, chart layout/time-based, list layout/event-based, and list layout/time-based.

- Chart layout/event-based: Participants' plans were coded within this category if the plan had a cue that was a chart and an event. In addition, participants' plans were coded within this category if they used a mixed cue or a mixed layout. The decision to combine the two mixed categories within this category was made because the development of a chart and the use of an event-based cue required the planner to conceptualize the planning activity at a higher level because the medications/groups were already presented in a list to the participants and participants were told that their week would be presented to them hour-by-hour. Therefore, mixed cues and mixed plan layouts were categorized under chart for plan layout and event-based for cue. The following is a list of plan categories coded within this category:
    - Chart layout/event-based cue
    - Mixed layout/event-based cue
    - Chart layout/mixed based cue
    - Mixed layout/mixed based cue
- Chart layout/time-based: Participants' plans were coded within this category if the plan had a cue that was coded as time-based and a layout that was either a

chart or a mix between the two. The following is a list of plan categories coded within this category:

  - Chart layout/time-based cue
  - Mixed layout/time-based cue

- List layout/event-based: Participants' plans were coded within this category if the plan had a cue that was coded as event-based or mixed based and a layout that was a list. The following is a list of plan categories coded within this category:
  - List layout/event-based cue
  - List layout/mixed cue
- List layout/time-based cue: Participants' plans were coded within this category if the plan had a cue that was time-based and a list layout. The following is a list of plan categories coded within this category:
  - List layout/time-based cue

APPENDIX E

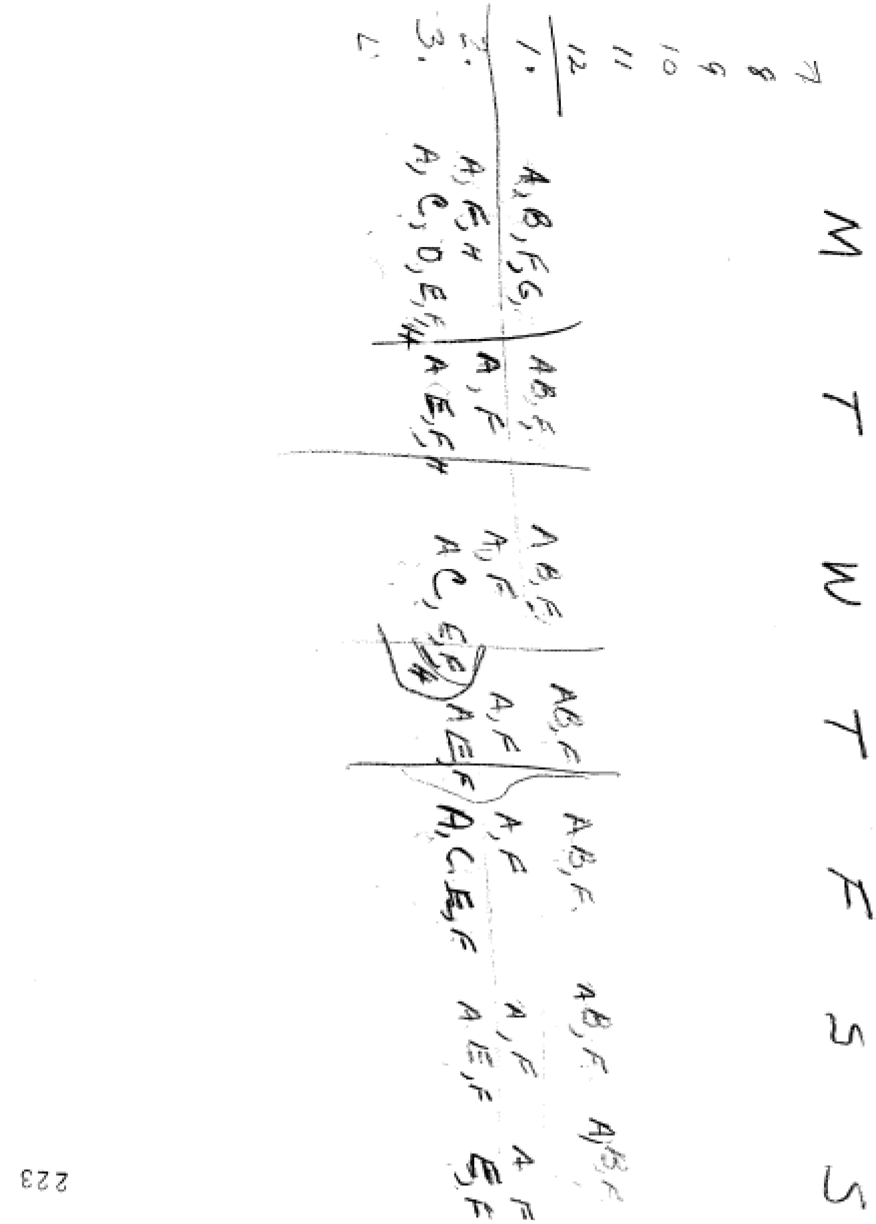
PLANNING STYLES

Chart layout/Time-based Planning Style (Younger Adult)

107

	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
7							
8							
9							
10							
11	C		C		C		
12	B	B	B	B	B	B	B
1	A, F	AF	AF	AF	AF	AF	AF
2							
3				D, G			
4							
5	A, F	AF	AF	AF	AF	AF	AF
6							
7							
8	E	E	E	E	E	E	E
9	AF, H	AF	AF, H	AF, [illegible]	AF, H	AF	AF
10							
11							
12							

Chart layout/Time-based Planning Style (Older Adult)



List layout/Time-based Planning Style (Younger Adult)

105. . .

A
Mon-Sun
@ 1 pM
@ 5 pM
@ 7 pM

B
Mon-Sun
@ 9 aM

C
M|W|F @ noon

D
Sunday @ 1 pM

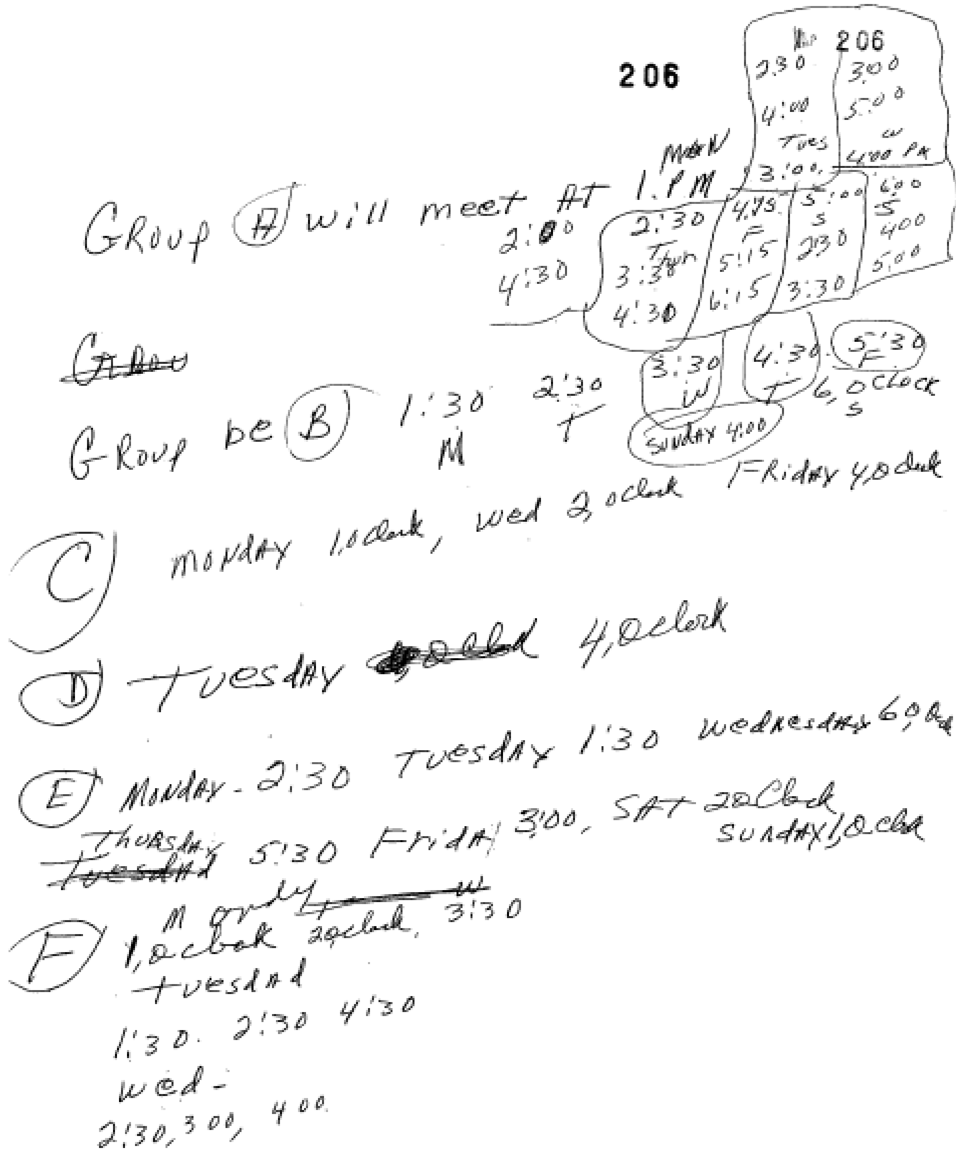
E
Mon-Sun @ 10 am

F
Mon- Sun
@ 8 aM
@ 2 pM
@ 5 pM

G
Saturday @ 1 pm

H
T/Thur/sun @
8 pm

List layout/Time-based Planning Style (Older Adult)


206

Group A will meet AT 1 PM
2:00
4:30

~~Group~~
Group be B 1:30 M 2:30 T

C) Monday 1,oclock, wed 2,oclock Friday 4,oclock

D) Tuesday ~~[illegible]~~ 4,oclock

E) Monday - 2:30 Tuesday 1:30 wednesday 6,oclock
~~Tuesday~~ Thursday 5:30 Friday 3:00, SAT 2oClock Sunday 1,oClock

F) 1,oclock ~~Monday~~ 2oclock, ~~W~~ 3:30
tuesday
1:30. 2:30 4:30
wed -
2:30, 3:00, 4:00

Chart layout/Event-based Planning Style (Younger Adult)

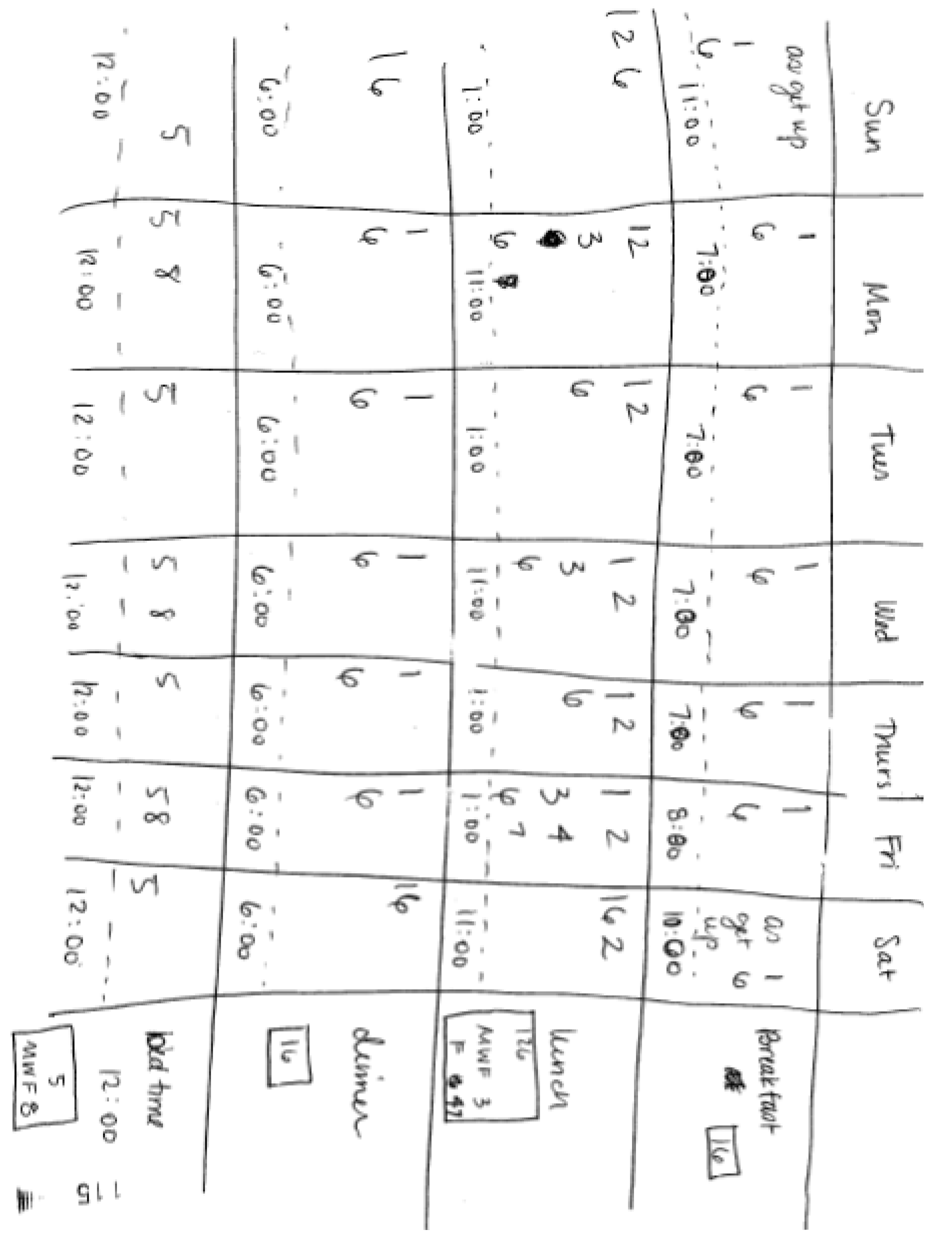
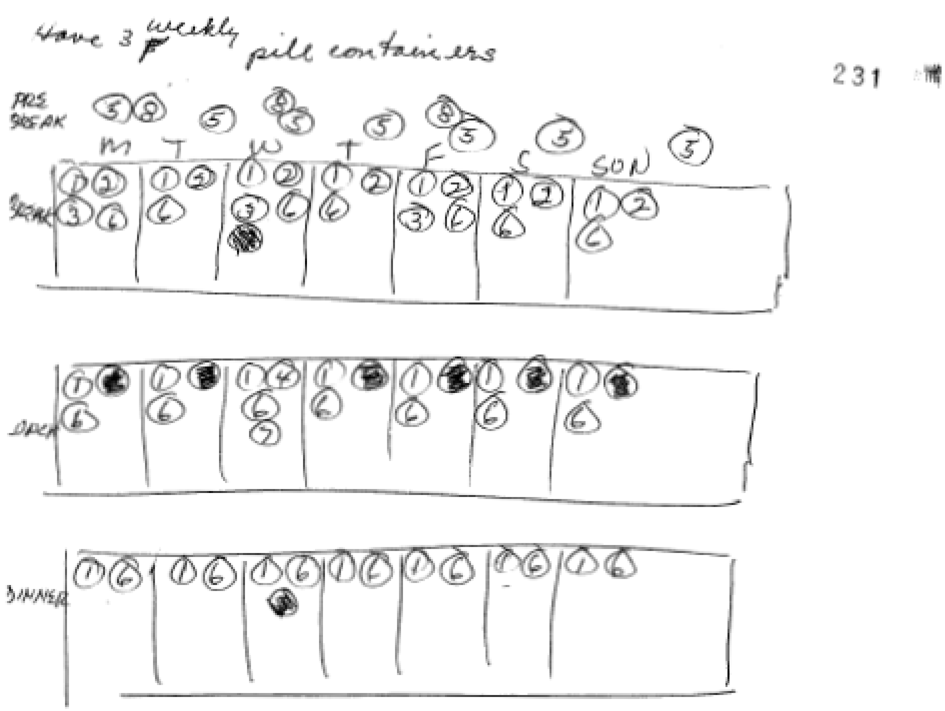
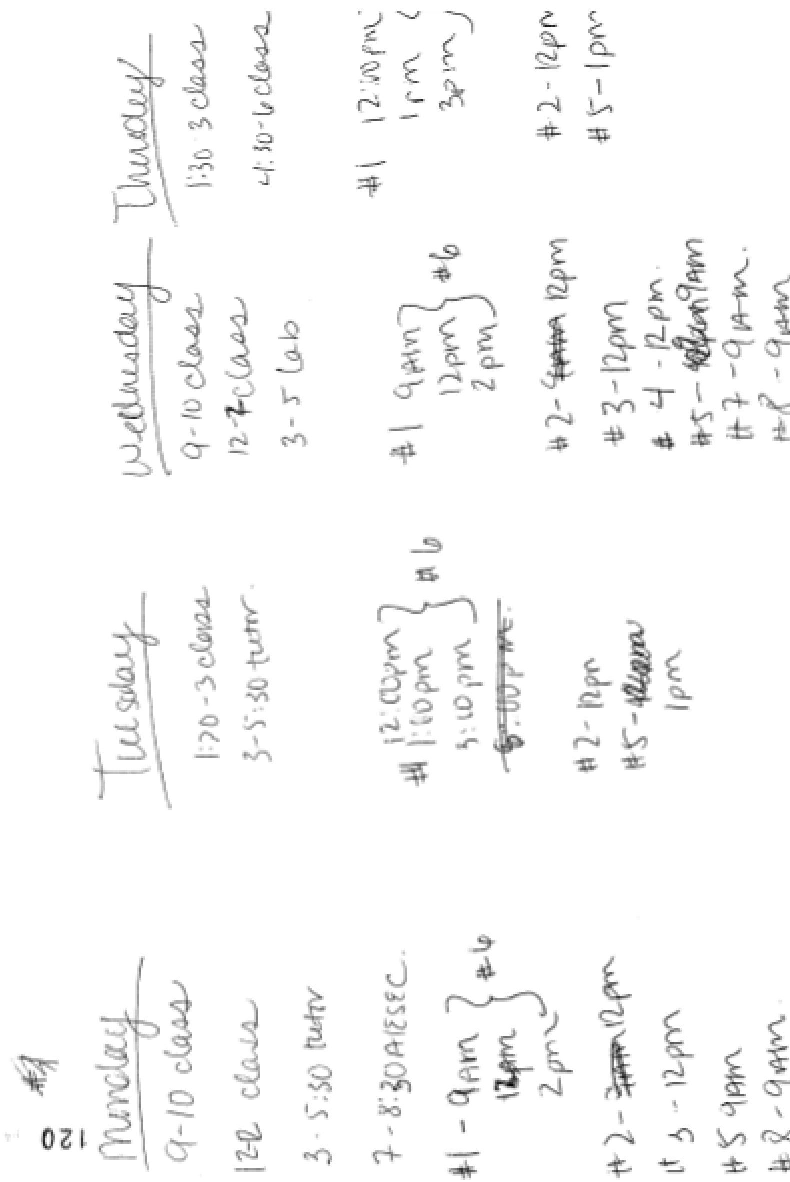


Chart layout/Event-based Planning Style (Older Adult)



List layout/Event-based Planning Style (Younger Adult)


120 #

Monday
9-10 class
12-2 class
3-5:30 tutor
7-8:30 AIESEC
#1 - 9am, 12pm, 2pm } #6
#2 - 12pm
#3 - 12pm
#5 9pm
#8 - 9am

Tuesday
1:30-3 class
3-5:30 tutor
#1 12:00pm, 1:00pm, 3:10pm } #6
~~6:00pm~~
#2 - 12pm
#5 - 1pm

Wednesday
9-10 class
12-2 class
3-5 lab
#1 9am, 12pm, 2pm } #6
#2 - 12pm
#3 - 12pm
#4 - 12pm
#5 - 9am
#7 - 9am
#8 - 9am

Thursday
1:30-3 class
4:30-6 class
#1 12:30pm, 1pm, 3pm
#2 - 12pm
#5 - 1pm

List layout/Event-based Planning Style (Older Adult)

233

#1 3x ev day (B, L, Din)

123 - Break.

Lunch

1

1 6 8 Din

#2 1X ev day (B)

#3 1x (3 diff days) (M W F) @ Break

#4 1X on 1 day (M-Sun) (MON, 12PM Lunch 1x)

Not bef. 12PM

#5 1X, ev day (before breakf.) WAKE-UP

No Food

#6 beg 7am 11am 4Pm WAKE-UP

3x, diff Times daily 1 2 3

#7 1X, 1 day | MON, bed-Time

#8 ~~1X~~, 3 diff day, 4PM 4PM 4PM (M, W, F)

No food

REFERENCES

Bisiacchi, P. S., Sgaramella, T. M., & Farinello, C. (1998). Planning strategies and control mechanisms: Evidence from closed head injury and aging. *Brain and Cognition, 37*, 113-116.

Chasteen, A. L., Park, D. C., & Schwarz, N. (2001). Implementation intentions and facilitation of prospective memory. *Psychological Science, 12*, 457-461.

Cohen, A. L., West, R., & Craik, F. I. M. (2001). Modulation of the prospective and retrospective components of memory for intentions in younger and older adults. *Aging, Neuropsychology, & Cognition, 8*, 1-13.

Craik, F. I. M. (1977). Age differences in human memory. In J.E. Birren & K.W. Schaie (Eds.), *Handbook of the psychology of aging* (pp. 384-420). New York: Van Nostrand Reinhold.

Craik, F. I. M. (1983). On the transfer of information from temporary to permanent memory. *Philosophical Transactions of the Royal Society of London, 302*, 341-359.

Craik, F. I. M. (1986). A functional account of age differences in memory. In F. Klix & H. Hagendorf (Eds.), *Human memory and cognitive capabilities* (pp. 409-422). North Holland: Elsevier.

Craik, F. I. M., & Bialystok, E. (in press). Planning and task management in older adults: Cooking breakfast. *Memory & Cognition*.

Craik, F. I. M., & Kerr, S. A. (1996). Prospective memory, aging, and lapses of intention. In M. Brandimonte, G. O. Einstein, & M. A. McDaniel (Eds.), *Prospective theory: Theory and applications* (pp. 227-237). Mahwah: Erlbaum Associates.

Craik, F. I. M., & McDowd, J. M. (1998). Age differences in recall and recognition. In M. P. Lawton & T. A. Salthouse (Eds.), *Essential papers on the psychology of aging* (pp. 282-295). New York: New York University Press.

Crovitz, H. F., & Daniel, W. F. (1984). Measurements of everyday memory: Toward the prevention of forgetting. *Bulletin of the Psychonomic Society, 22*, 413-414.

Dobbs, A. R.., & Reeves, B. M. (1996). Prospective memory: More than memory. In M. Brandimonte & G. O. Einstein (Eds.), *Prospective memory: Theory and applications* (pp. 199-225). Mahwah, NJ: Erlbaum.

Dobbs, A. R., & Rule, B. G. (1987). Prospective memory and self-reports of memory abilities in older adults. *Canadian Journal of Psychology, 41*, 209-222.

Einstein, G. O., & McDaniel, M. A. (1990). Normal aging and prospective memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*, 717-726.

Einstein, G. O., McDaniel, M. A., Richardson, S. L., Guynn, M. J., & Cunfer, A. R. (1995). Aging and prospective memory: Examining the influences of self-initiated retrieval processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 996-1007.

Ellis, J. (1996). Prospective memory or the realization of delayed intentions: A conceptual framework for research. In M. Brandimonte & G. O. Einstein (Eds.), *Prospective memory: Theory and applications* (pp. 1-22). Mahwah, NJ: Erlbaum.

Kvavilashvili, L., & Ellis, J. (1996). Varieties of intention: Some distinctions and classifications. In M. Brandimonte & G. O. Einstein (Eds.), *Prospective memory: Theory and applications* (pp. 23-51). Mahwah, NJ: Erlbaum.

Garden, S. E., Phillips, L. H., & McPherson, S. E. (2001). Mid-life aging, open-ended planning and laboratory measures of executive function. *Neuropsychology, 15*, 472-482.

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The international personality item pool and the future of public-domain personality measures. Journal of Research in Personality, 40, 84-96. Sample items available online: http://ipip.ori.org/ipip

Gould, O. N., McDonald-Miszczak, L. & King, B. (1997). Metacognition and medication adherence: How do older adults remember? *Experimental Aging Research, 23*, 315-342.

Henry, J. D., MacLeod, M. S., Phillips, L. H., & Crawford, J. R. (2004). A meta-analytic review of prospective memory and aging. *Psychology and Aging, 19*, 27-39.

Kliegel, M., & Martin, M. (2003). Prospective memory research: Why is it relevant? *International Journal of Psychology, 38*, 193-194.

Kliegel, M., Martin, M., & Moor, C. (2003). Prospective memory and aging: Is task importance relevant? *International Journal of Psychology, 38*, 207-214.

Lachman, M. E., & Burack, O. R. (1993). Planning and control processes across the life span: An overview. *International Journal of Behavioral Development, 16*, 131-143.

Light, L. L. (1991). Memory and aging: Four hypotheses in search of data. *Annual Review of Psychology, 42*, 333-376.

Loewen, R. E., Shaw, R. J., & Craik, F. I. M. (1990). Age differences in components of metamemory. *Experimental Aging Research, 16*, 43-48.

Marsh, R. L., Hicks, J. L., & Cook, G. I. (2005). On the relationship between effort toward an ongoing task and cue detection in event-based prospective memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*, 68-75.

Marsh, R. L., Hicks, J. L., & Landau, J. D. (1998). An investigation of everyday prospective memory. *Memory & Cognition, 26*, 633-643.

Martin, M., & Ewert, O. (1997). Attention and planning in older adults. *International Journal of Behavioral Development, 20*, 577-594.

Martin, M., Kliegel, M., & McDaniel, M. A. (2003). The involvement of executive functions in prospective memory performance of adults. *International Journal of Psychology, 38*, 195-206.

Maylor, E. A. (1990). Age and prospective memory. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 42*, 471-493.

Morrell, R. W., Park, D. C., Kidder, D. P., & Martin, M. (1997). Adherence to antihypertensive medications across the life span. *The Gerontologist, 37*, 1-11.

Morris, R, & Ward, G. (Eds.) (2005). *The cognitive psychology of planning*. New York: Psychology Press.

Phillips, L. H., MacLeod, M. S., & Kliegel, M. (2005). Adult aging and cognitive planning. In R. Morris & G. Ward (Eds.), *The cognitive psychology of planning* (pp. 111-134). Hove, UK: Psychology Press.

Rendell, P. G., & Thomson, D. M. (1993). Aging and prospective memory: Differences between naturalistic and laboratory tasks. *Journal of Gerontology: Psychological Sciences, 54B*, P256-P269.

Rendell, P. G., & Thomson, D. M. (1999). Aging and prospective memory: Differences between naturalistic and laboratory tasks. *Journal of Gerontology: Psychological Sciences, 54B*, P256-P269.

Salthouse, T. A. (1982). *Adult cognition: An experimental psychology of human aging*. New York: Springer-Verlag.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime User's Guide: Psychology Software Tools Inc*. Pittsburgh.

Schonfield, D., & Robertson, B. A. (1966). Memory storage and aging. *Canadian Journal of Psychology, 20*, 228-236.

Shipley, W. C. (1986) *Shipley Institute of Living Scale*. Los Angeles: Western Psychological Services.

Terry, W. S. (1988). Everyday forgetting: Data from a diary study. *Psychological Reports, 62*, 299-303.

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior Research Methods, 37*, 498-505.

Wechsler, D. (1981) *Manual for Wechsler Memory Scale Revised*. New York: The Psychological Corporation.

Zacks, R. T., Hasher, L., & Li, K. Z. H. (2000). Human memory. In F.I.M. Craik and T.A. Salthouse (Eds.), *The handbook of aging and cognition* (pp. 293-357). Mahwah, NJ: Erlbaum.